GEOGRAPHIC INFORMATION SYSTEMS: A REVIEW OF COUNTY SPATIAL AND ATTRIBUTIVE DATA NEEDS AND APPLICATIONS

by

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CHAPTER ONE

INTRODUCTION

Planning is secure when it rests on the solid foundation of information; data or facts. When one looks at the daily work of the typical planner; there is little doubt that a planner cannot plan without information. Plans are not built just on analysis, but on the foundation of accurate and current information. With current computer technology, the cost and skill required to maintain and manipulate information is decreasing while the cost of information acquisition is ever increasing. The reasoning is simple, data maintenance and manipulation can be performed by the technology (computers) while the cost of acquiring data is still primarily a manual process. Even with the invention of the computer survey card, since there is a human cost in acquiring even this information, the cost shall by fiat be forever increasing. As Russell Getter, Director of The Kansas Division of Information Systems and Communications, said at a recent Geographic Information Systems Conference in Lawrence, Kansas, "So long as I receive my mail by a U.S. Mail carrier the 'information age' has not arrived."

In balancing the costs and benefits obtained from information the planner must decide what information can be maintained, purchased, and used with the greatest benefit, breadth, and longevity for the most users. For the initial cost of information the question is, "what will give the most users the greatest utility from the collected

data?" Information collection, whether it be a land survey or a population survey, can no longer waste precious monetary resources on single application data generation.

As information is being transformed into a marketable good, the various data bases that a planner is responsible for have increased in value. Information is no longer of value only to specific plans or applications, but, if maintained and updated, have utility to outside interests. A planner can serve as the broker of this information inventory; if, and there is always an if, the information is maintained in an easily malleable form. Such malleability is the inherent attribute of a Geographic Information System (GIS).

PROBLEM DEFINITION

The question arises, given that information collection is costly and time is an even more costly, what information should be collected first? Specifically, what information will be necessary to produce the greatest utility from a GIS? The answer appears to be that information which produces the greatest utility to the most users. What information gives the greatest utility to the most users? This is the crux of the problem and it is the purpose of this research to determine what information gives the greatest utility to the most users in a spatial geographic data processing environment or GIS.

This report is a case study of Riley County offices and departments. It's purpose is to serve as a source document as a descriptive inventory of how Riley County collects, maintains, and

applies various spatial and attributive data bases. Each explicit unit of Riley County government has been inventoried. Of course, it is impossible to list and inventory all potential users and generators of information at and for the county level of government. For example, school districts, townships, benefit districts, state agencies, and federal departments applications and data base information are not inventoried in this study outside of the information that is applied by explicit Riley County units of government. This is not to diminish the value of these other units of government but to point out to the reader there are other levels of users that would need to be considered in the implementation of a geographic information system.

ORGANIZATION OF PROJECT

The organization of this project shall be in five chapters.

1) The first chapter is this introduction of the project.

2) The second chapter includes a general discussion of GIS and definition of relevant terms and concepts. GIS applications are promoted for an understanding of later chapters. This chapter summarizes the experience and concerns of professionals in the field of GIS as they relate to the implementation process, political will, needed information files, and economic support.

3) The third chapter provides an assumption statement; defines the research scope; gives a statement of the problem; states the significance of the study, its immediate benefits and future implications; states the goal of the research and research objectives.

4) The forth chapter reviews pertinent and explicit offices and departments in Riley County and inventories the present information each maintains and uses as it relates to spatial characteristics that would be of utility in a GIS environment to their duties and responsibilities. Each office or department represents a separate section in this chapter to better understand their information needs. Also, put forward is a brief discussion of what will be gained from reappraisal and what reappraisal means in a GIS context to a county government.

5) The final chapter ties together the various county spatial and attributive data bases in a network and matrix model to illustrate these relationships.

CHAPTER TWO

GIS IN GENERAL

What is a geographic information system? This is a critical issue of concern. To formulate a response it would be more helpful to clarify what a geographic information system is not. GIS is not computer-aided mapping (CAM) or computer-aided drafting (CAD). Kennth Dueker explains in a coherent manner the relationship of CAM and CAD systems.

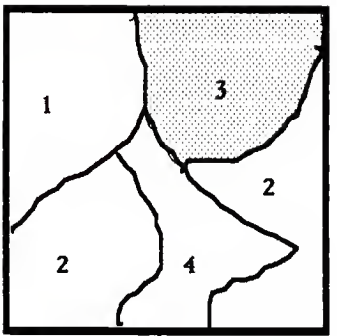
> "[(CAD)] systems are well developed tools in architectural, electrical, and mechanical engineering. When applied to mapmaking, CAD is referred to as computer-aided mapping (CAM). CAM, is a display-oriented technology like CAD consists of points and lines stored in one or more data layers. The layers can be displayed separately or in combination; the data intended for CAD are not structured to allow spatial analysis." (Dueker 1987, p.383)

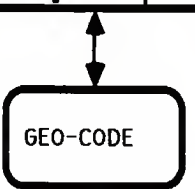
Though not one to quote a dictionary it would expedite a solution to the problem. As defined in The American Heritage Dictionary (1979), "Geographic" is that which is "concern[ed with the] topography of a specific region (topography is further defined as "the detailed and accurate description of a place or region.")." "Information" can be defined as the "communication of knowledge." "Systems" may be defined as "a set of objects or phenomena grouped together for classification or analysis." Thus, it can be concluded that a

geographic information system is the joining of topographic (spatial) data and knowledge (descriptive data) of a given place or region with an intent to use the two elements for data classification and analysis.

A CAD or CAM system is one part of the GIS equation. In computer software development, it is common for a generic program to be integrated with another program to create a modular software system. An example of this is the GIS software ARC/INFO from the Environmental Systems Research Institute (ESRI) in Redlands, California. ESRI describes ARC/INFO, in a product brochure, as a system that "brings together a strong geographic analysis and modeling capability with a complete interactive system for entry, management and computer display of spatial data." (ESRI)

The following Figure illustrates this relationship between spatial and descriptive data in a GIS environment. The data shown on the upper part in this diagram is a set of polygons or areas that are correlated, through a geo-code, with the descriptive data on the lower half of the diagram.





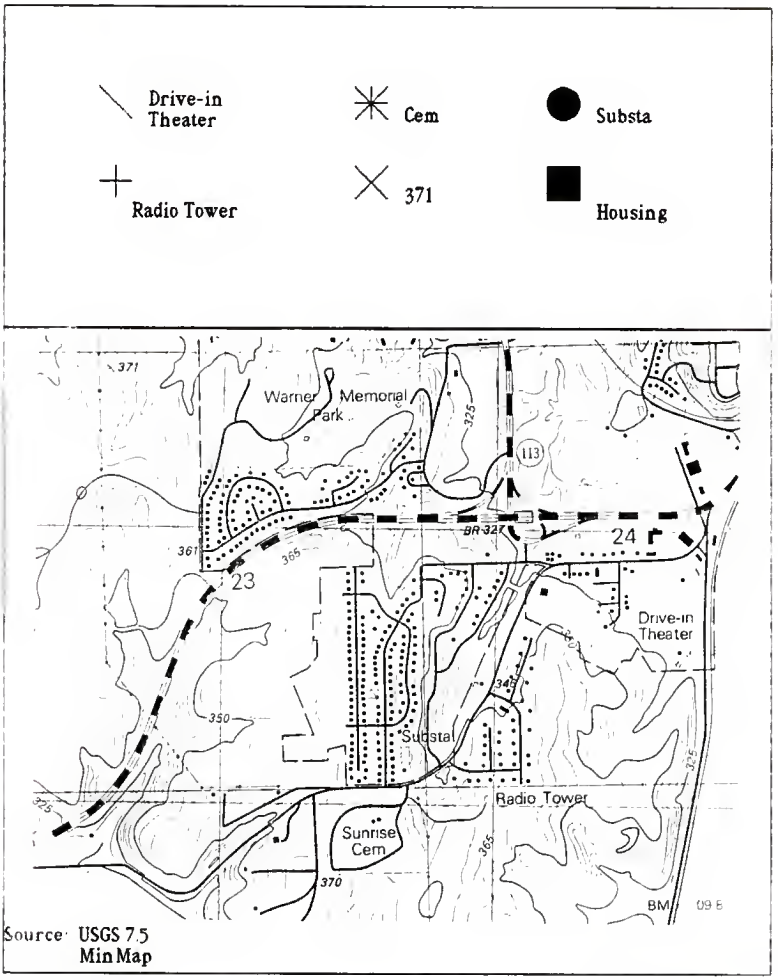
POLITICAL DISTRICT	ZONING	FIRE RESPONSE	SCHOOL DISTRICT	AND SO ON
1	R-1	FH1	E2	
2	C-2	FH3	E3	
3	R-4	FH3	E3	
4	I-2	FH3	E2	

GEO-CODE LINK DIAGRAM
FIGURE - 1

GIS TERMS & DEFINITIONS

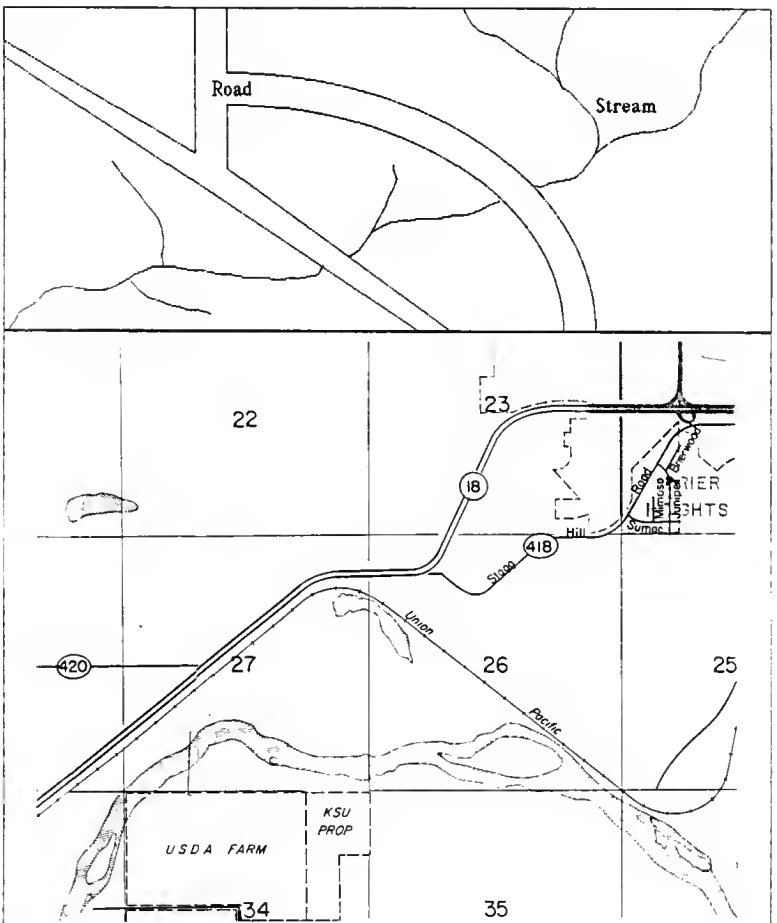
In defining just what is meant by the terms "attributive" and "spatial" data bases, the author has concluded that an answer can be found in the inherent relationship between these two forms of data. Specifically, spatial data may be represented in points, lines, or areas. Attributive data is defined as descriptive or tabular data that defines these spatial representations.

A "point" is a symbol that represents a specific place where something in the real world is or where an event has taken place. Points have no length or area and can be thought of as having a single coordinate on a surface map. For example, a stop sign is a specific point; it may be considered to be a permanent representation of what is in the real world at a specific place at any given moment. When one considers an event, such as an automobile accident, this is an example of an event that took place at a specific place. For example, the accident happened at the intersection of Main and Vine Street.



POINTS
FIGURE - 2

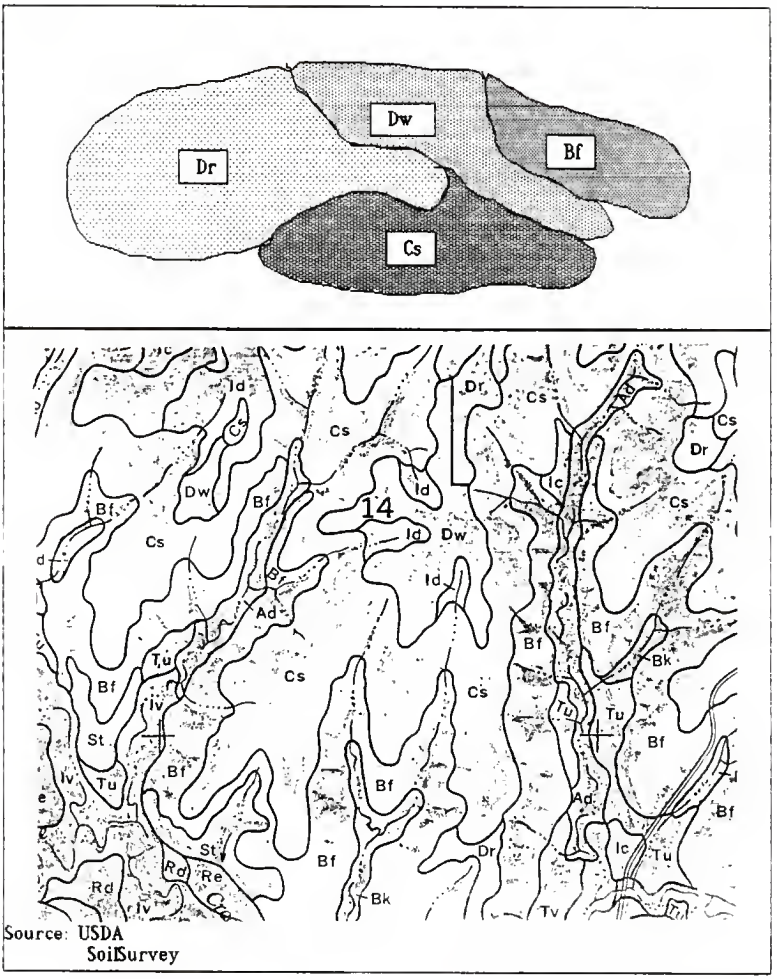
A "line" is a linear feature that typical represents a rivers, utility lines, or roads. Lines have no area but may be thought of as being a string of coordinates with a beginning and ending point. Frequently, this is little more than beginning at one point of a map and ending on the other side.



Source: Map of
Riley County Kansas

LINES
FIGURE - 3

A "area" is a feature with boundaries and represents an area. Typically, a polygon is used to represent land parcels, building foot prints, political districts, or soil boundaries. One can think of an area as being a string of coordinates with the same beginning and ending point. Whatever is within this loop represents the given area and description.



AREA OR POLYGON
FIGURE - 4

There is an implied statement in the above definition of terms. Point, lines, and polygons are attributes of vector data encoding. It is not necessary, for the purpose of this study, to dwell on the differences in GIS programs. A brief discussion, however, must be pursued.

There are two major schemes for data encoding in geographic information systems: vector encoding and raster encoding. A raster encoding format is similar to a grid system of encoding and is defined as "geographic information systems in which data are encoded and stored as regular units, usually square or rectangular units called grids or cells. Data have to be generalized in the encoding process, resulting in some loss of accuracy (Schneider 1979)." A raster encoding format is not normally or easily formatted in providing point and line data, as would be necessary for the generation of detailed property maps, these systems shall not be considered for a county GIS system in Kansas.

GIS APPLICATIONS

A GIS joins spatial and descriptive data bases. But, these separate data bases, in a true GIS environment, may also be executed, in a sense, without relation to the parallel data base. For example, a GIS would serve as an ideal cadastral mapping system. Cadastral

mapping is of great concern for local and county governments in Kansas with the reappraisal mandate from state government.

Descriptive data, linked to the spatial data by a geo-code, in many GIS packages are able to manipulate the data using a whole host of statistical methods. The system is often able to perform standard comparative tests like the cross-tabulation of two or more variables to determine any joint frequency distribution of cases. What is required is a fully functional statistics applications program to be a part of the descriptive or attributive component of the GIS. Besides cross-tabulation a true GIS should be able to generate in an easily accessible format functions similar to, for example, the Statistical Package for the Social Sciences (SPSS). The point should be made that if a GIS software doesn't make the leap into the statistical world of analysis it is really nothing more than a CAM connected to a spread sheet. The statistical analysis capability is what makes a GIS a "true" geographic information system.

Modeling overlay techniques are well suited for most geographic information systems. Overlay modeling GIS applications will be discussed in the "Information Section" of this document as the various techniques imply a "necessary" data base for such modeling.

The following is a brief list of GIS applications. These are applications which have been proven useful to local levels of government. This list is offered for the readers enlightenment and it should be noted most are direct quotations found in selected GIS literature. It serves the purpose of this study to offer the reader a

stimulating perception of the potential uses that can be obtained from a GIS.

General Plan Update - "Computer overlay the existing land use map on the current zoning map, identify sites where the two are in conflict, determine the existing uses and zoning of contiguous parcels, then produce a map showing where all the above occur." (Castle, p.72)

Environmental Impact - "Pass this proposed subdivision boundary through all the maps in the data base, then generate a report listing adverse encounters (such as. flood plain, poor soils, no slack sewer capacity, critical wildlife habitat)." (Castle, p.72)

Facility Siting - "Identify feasible parcels for an elderly housing project using the criteria of currently vacant land, desired residential density, within 100 yards of a bus route, in a police precinct with a below average crime rate." (Castle, p.72)

Urbanization Forecasts - "Draw a map showing all residential areas in the year 1990 based on the residential categories in the existing land use map and base on the locations, number of units, and proposed buildout schedules of all subdivision applications currently in the approval pipeline." (Castle, p.72)

Fiscal Impact Analysis - "For those same subdivisions in the approval pipeline, determine the distance from each subdivision to the nearest trunk water line, then calculate the approximate cost of the requisite linear feet of pipe; also, calculate the cumulative increase in gallons per day needed by those subdivisions, and identify any water lines lacking slack capacity to meet those needs." (Castle, p.72)

Arson Prediction - "An arson incidence map [using] overlay[s] that map on other socioeconomic data layers to produce an arson prediction model." (Castle, p.80)

Computer Aided Mass Appraisal - "By overlaying various land use, zoning, and economic data layers to identify homogeneous assessment zones, then correlating those to assessed valuations from the parcel file [can assist the assessor in CAMA methods]." (Castle, p.80)

Housing Market Trends - a map showing the point location of dwellings sold serves as a graphical means to analyses trends in the marketplace. (Burns, p.100)

Airport Comprehensive Plan - By correlating building height and impacted parcel with noise impact zones a percentage of properties that are impacted by an airport can be obtained. (Burns, p.100)

Rezoning Hearing Process - "[P]lanners in Las Vegas examined contour lines, footprints of surrounding buildings, area zoning patterns, surrounding land uses, and environmental issues. With this information, they were able to go through and analyses the map looking at where impacts are. Finally, they worked down to specific detail and looked at what lots belong to what owners to determine what notices have to be sent out. The system was then used to generate a mailing list." (Burns, p.102)

Sewer Lines - Based on specific parcel data placement of sewer lines is aided. By basing the study on sewer line intersections and determining what parcels are served by a particular sewer line and corresponding this data with attribute informations, such as angle or elevation of the line, slope, date of installation, manufacture, capacity, flow by gravity or lift station a "report based on street addresses and displayed attribute data for those lots served by [a] particular sewer line" can be generated. (Burns, p.102)

Flood Control - By overlaying residential land use sections with administrative boundary data, zoning data and 100 year flood plain data Anchorage was able to determine what residential lots were impacted by the 100 year flood plain. (Burns, p.102)

Road Extension Suitability - By using existing data to determine slope stability, foundation conditions, wildlife habitat, vegetation, wetlands, and geology the City of Anchorage was able to determine "high straining and areas of potential straining for certain conditions." (Burns, p.103)

Groundwater Pollution - By locating all septic tanks in a study area and cross tabulating this with density, lot location, groundwater depth, soil type, and slope potential groundwater pollution areas were determined. (Burns, p.103)

Land Acquisition - In the process of acquiring a greenbelt Anchorage used its GIS to determine "what property the greenbelt would go through and what percentage of those properties would be impacted. The GIS offered one way to explore how much money land acquisition would take." The final report "showed the land use, current tax, and geographic ID of the parcels." The system aided in preparing a mail-out to property owners. (Burns, p.104)

School Enrollment - A "GIS was used by the School District to look at area boundary data and high school attendance areas. Students move back and forth across these boundaries, making it hard to know what the total enrollment is. [A GIS was used to take] "student records and match [them] to properties, showing 1,300 7th graders and 900 9th graders. The system was then used to reallocate students among districts, use[ing] the system to allocate them, or redistrict enrollment. (Burns, p.104)

Acreage Calculations and Tabular Data Generation - Though a rather expensive planimeter, GIS may be used for the "calculation of acreages for different types of data. The number of acres in residential land use, the number of acres zoned for industry, or the number of acres of wetlands in a region." (Schneider, p.5)

Water Quality Management - GIS can be "used with some of the standard models for nonpoint-source pollution." "These models use the information on slope, drainage patterns, land

use, storm volume and duration, and runoff generation from different land uses to estimate stream pollutant loadings." (Schneider, p.9)

Resource Management - GIS can be used to "plan for future development and to monitor resource development." A GIS may be used to "experiment with different assumptions about agricultural production." (Schneider, p.9)

Public Facilities Planning - By using overlay techniques it is possible to "identify suitable sites for such potentially problematic uses as sanitary landfills. Identifying suitable sites is essentially a process of eliminating sites that are unsuitable." (Schneider, p.11)

IMPLEMENTATION PROCESS

Underlying these modeling applications is the data. Even as the cost of these systems decrease, a sophisticated software package can be purchased in a range between $50.00 (public domain) to $150,000 (turnkey system)(Gray 1985), down from the millions that were spent creating earlier inhouse programs, the cost of data is on the rise. GIS, for the sake of having the technology is a poor bargain indeed. The benefit of a GIS is to better understand what is happening in the real world. If the data is sufficient in size, it is possible to draw conclusions that are not the result of a sample size but the determination of 100 percent of the population at any given moment. Public concerns and needs can be inferred from the behavior of the physical landscape. This, and other modeling technics, have only just

begun to be explored. A persons home says a great deal about the condition and wishes of the "kingdom." Imagine the power of such systems not only for orderly planning, but for the marketing of products and services. There are real ethical questions that need to be addressed before the procurement of such systems. A basic understanding of the "social and cultural goals" of a community need to be evaluated before the acquisition of any GIS takes place (Chrisman 1987).

Though this research is focussed at determining the information needs of a geographic information system, an important aspect to the implementation process is that of coalition building (Byler 1980). As with any large commitment, before the implementation stage can even begin, it is "crucial to have the support of elected officials, planning commissioners, and agency heads. Without this type of support, the process could be slowed or halted at any time through lack of financial or staff commitment (Schneider 1979)." A key in maintaining these coalitions is results and it is "advisable to develop the system as quickly as possible -- developing the ability to show products and apply the system to planning problems. One of the main reasons for this is political considerations. Financial support for the system may wane if agency heads, planning commissioners, or elected officials see no results over a period during which expenditure for the project are apt to be high (Schneider 1979, p. 29)."

According to Edward Crane, Project Director of Wyandotte County Base Mapping Program, Wyandotte County's GIS didn't cost the

taxpayers one dollar. In the amount of property that was found not to be on the tax rolls more than compensated for any cost incurred in the implementation of a GIS. Property owners were faced with "significant," delinquent tax bills that had not been paid on their property. The level of political will is something that must be determined. Yet, cost is the main point of attack used by most officials. And, cost is a real point of contention. Wyandotte County's GIS didn't magically pick out the delinquent parcels, there was a significant front end investment in inputting existing data and collecting data. This information management is also not a one time cost. Such system data bases must be vigilantly updated as the built and natural environment are dynamic in character.

Rebecca Sommers presented a GIS Development Process model at the Kansas GIS Conference (9/12/87). In the appendix is an outline of her model, but listed under the first step, the "Feasibility Study," is the subsection "Management Involvement." Sommers did not elaborate greatly on the detail of this model, except to say that sometime these systems fall short of implementation or fail after implementation because of a lack of will on the part of administrators and elected officials. Apparently, too often decision-makers are impressed by the graphic displays of these systems and researchers fall in love with the analysis capabilities. Somewhere along the way, however, both groups forget that data has to be collected and this is the major cost of GIS. Fortunately, in the case of Kansas, much the

basic data is already collected or is being collected; as is shown in Chapter Four.

It is apparent, from previous discussion, what a GIS is, what some of the analysis benefits are, and what the system costs are. The real task is to build coalitions and a constituency of users and to communicate ideas. The place to begin is marketing the system. The answers to some basic marketing questions need to be determined. What are the various governmental, citizenry, and commercial needs for GIS? Who are these users? At what price should such services be given? What is a realistic time frame in implementing a GIS? How can interest be maintained during the "System Acquisition" and "Data Conversion" stage of development? What user priorities should be given? How will the initial cost outlays be met? It is clear from literature (Getter, Dueker, Ertel, Schneider, and Byler) that such information systems fail to realize their full potential or meet delays if these issues are not addressed in a "Feasibility Study."

INFORMATION FILES

The development of information files for planning purposes, besides existing uses is and important consideration for any geographic information system. In this framework of determining other possible information data bases or uses, three possible modeling overlay techniques are reviewed with an emphasis placed on what

information was inventoried for the analysis model. The modeling puts the information in a framework for understanding the use of the data what is of concern here is the data that was collected and as a side its application. Three data collections requirements shall be reviewed in the context of an: Ecological Planning Information System; Recreation Resource Planning Modeling; and a Housing Site Location Suitability Model.

Ecological Planning Information -- As a part of the "Local Department of Health and Environment Act" that the Kansas Water Office is promoting a provision that would require the preparation of a "countywide comprehensive environmental protection operating strategies . . . (Kansas Water Office 1987)." Such a comprehensive study would require the mass inventory of the county environment as applied to ecological planning models. One such inventory model is the "Steiner--Brooks Model" which is in essence a layer cake model that seeks to collect data "on the appropriate physical, biological, and social factors that make up the region (Steiner 1978)."

Much of the information needs for each layer may be compiled "by planners using available published and mapped data (Steiner 1978)." This layer cake model details the environment from the micro level to the macro environment. For example, any given land area will have some element of ground water and surface water; which is a part of the hydrology of that area; which is a part of the physical characteristics of the area. Though the following is not a mathematical

formula per se, this model can be better understood by the following expression:

(Surface H_2O = Aquifers = Ground H_2O) ‹ (Hydrology) ‹ (Physical)

This formula is only one expression or layer of the model. In total there are 17 micro-layers, 9 mid-ranged layers, and 3 macro-layers. Expressing these layers as the above formula and in the three macro groups; they are:

(People) ‹ (Socio-Cultural) ‹ (Socio-Cultural)

(Mammals = Birds = Reptiles = Fish) ‹ (Wildlife) ‹ (Biological)
(Micro-Climate = Macro-Climate) ‹ (Climate) ‹ (Biological)
(Plants) ‹ (Vegetation) ‹ (Biological)

(Surface H_2O = Aquifers = Ground H_2O) ‹ (Hydrology) ‹ (Physical)
(Soil Erosion = Soil Drainage = Soils) ‹ (Soils) ‹ (Physical)
(Elevation = Slope) ‹ (Physiography) ‹ (Physical)
(Bedrock Geology) ‹ (Geology) ‹ (Physical)

Recreation Resource Planning -- Philip Lewis offers a unique approach to land use planning and information collection processes and has made significant contributions in state and regional land use planning in Wisconsin (Belknap 1967). His approach to data collection and needs are focussed towards environmental resource studies and modeling. In the development of a public outdoor recreation model,

Lewis used overlay modeling techniques to inventory and locate major and additional recreation resources.

1. Natural features (major resources):

   a. Lakes and rivers (a lake less than 50 acres = 2; greater than 25,000 acres = 15)
   b. Surface drainage
      - amount of stream flow (based on cubic feet per second)
      - stream junctions (based on size relationships)
      - water trails (based on value for canoeing)
   c. Wetlands (based on size and type of ownership)
   d. Topography (based on relationship to water, number of hills, and their configuration)
   e. Sandy soils adjacent to water

2. Intrinsic symbols (additional natural resources)

   a. Physiographic features (highest point in county = 10; cave = 4)
   b. Water-associated features (rapids = 4; waterfall = 10)
   c. Wildlife (migration stop over point = 2)
   d. Crops (orchard = 1)

3. Scientific and Vulnerable Areas (prairie = 20; specimen trees = 10)

4. Extrinsic symbols (additional man-made resources)

   a. Water-associated projects (reservoir = 1; canals = 1)
   b. Water-associated spots and facilities (bathing beach = 2)
   c. Topographic-associated structures (lighthouse = 10; firetower = 2)
   d. Trails; camps; winter- sport facilities; wildlife and conservation (fish hatchery = 5; hunting preserve = 1); public or privately owned recreation lands (golf

courses, rifle ranges, airfields); cultural or historical features (covered bridges = 20; county fair = 1; ghost town = 5); archeological sites.

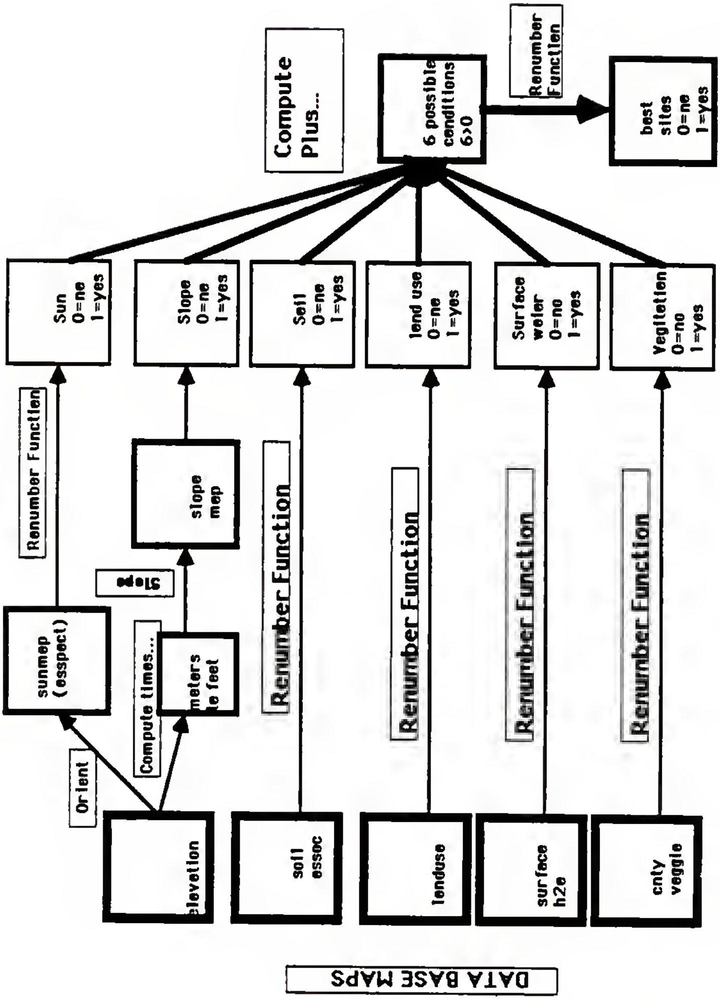
The process requires that these various inventories be "sandwiched" or overlayed to determine the "major" and "additional" resources and to see if any clear patterns are achieved in the dimensions of intrinsic and extrinsic resources. Priority areas are determined by totaling the points assigned to the above points. Thus, "areas to receive priority are identified when the points assigned to all resources are totaled."

His process in the use of overlays can be helpful in quickly understanding already collected data or in the process of collecting needed data. These techniques are more than suitable for a GIS working environment.

Housing Site Location Suitability Model -- The author has developed a "housing site location suitability model" that requires five (5) layers of information similar to the Steiner--Brooks layer cake model. Implementing a binary numbering of the various layers it is determined, whether the land is either suitable or not-suitable. This model was developed for the Professional Map Analysis Package (pMAP) a PC-GIS.

The five layers are: elevation; soil type; land use; surface H2O; and vegetation. Four of these layers, all except the elevation layer, are processed using the "renumber function" of pMAP expressing suitability as ether yes or no. The elevation layer is processed to

determine two additional layers: slope and aspect. These two additional layers are then expressed in this binary for suitability as either yes or no. These six binary maps are then computed to create an overlay of six possible conditions (a range of suitability). This final map is then renumbered to create a "best sites" map. The crux of this model is that it actually determines unsuitable sites. That is for each of the binary layers the question is asked, "what conditions are absolutely unsuitable for housing."



COUNTY HOUSING LOCATION MODEL
FIGURE - 5

CHAPTER THREE

ASSUMPTION STATEMENT

The underlying assumption of this research is that the existing data maintained and used by a county government, whether it be presently in a manual or automated format, is the information that will give the greatest utility to the most users in a spatial geographic data processing environment or GIS. Or, stated in the more esoteric, it is the assertion that; standards are manifested in the status quo.

RESEARCH SCOPE

The scope of this research is to attempt to determine the spatial geographic information needs of county governments in the State of Kansas. Typically, a hierarchical chart of the United States Government is viewed as an eight (8) layer model. At the top of this model is the federal government, then there are in descending order, interstate regions, individual states, intrastate regions, counties, townships, cities and lastly districts and/or wards.

Information is neither maintained nor used in a vacuum. The necessity in the use of information in planning vary; there are statute requirements, administrative necessities, and just plain common sense. It is a basic tenet of this research that, in a horizontal layer on

an organization chart, information needs are relatively the same; no doubt there may be greater and lessor needs and slightly differing uses for any given unit; but on the whole, if properly selected, one unit on a horizontal layer is representative of other units on the same plane. This is not to assert that all units in the United States require and maintain the same information, rather that other units under a single umbrella unit would have similar information requirements and needs. Specifically, documenting the information uses of a single county in Kansas would serve as a case study in determining the information needs of other counties in Kansas, but not necessarily counties in other states. Conceivably, each individual county could require sets of unique data, as well as a common core of information needs.

Because of its balance in rural/urban land uses and its being among those counties with a commitment to planning, Riley County is an ideal case study for this research and in the spirit of research. Riley County, the selected county of study, covers a total land area of 390,824 acres; about 66 percent is farmland; in which some 35 percent is for the harvesting of crops. The county has significant water resources with Tuttle Creek Reservoir covering about 5,000 acres in the county. There are five (5) incorporated cities in the county with the City of Manhattan, a First Class City, the tenth (10th) largest population in Kansas (Kansas Statistical Abstract 1985-86).

Riley County has demonstrated a real commitment to planning; of the 91 counties responding to a recent survey, Riley County is

among 67 counties with a planning board or commission. It is also among the 36 counties with a planning department. Further, it is among some 40 counties with subdivision regulations. And, is among 45 counties with zoning regulations (Deines 1984).

STATEMENT OF PROBLEM

As an inventory of information, there is a need to resolve what data of all types in a representative county--with significant rural and urban land uses--would require for the implementation of a geographic information system for the greatest number of county departments and offices.

SIGNIFICANCE OF THE STUDY

Immediate Benefits -- There are three immediate benefits that can be obtained from this study. First, the inventory of existing attributive and spatial data bases alone will aid Riley County in particular and other Kansas counties in general in obtaining information that is needed but are not known to exist by other county offices and departments. This research has documented 48 attributive data bases and 60 spatial data bases used and/or maintained by Riley County officials.

This study will aid administrative officials in reducing the redundancy in data bases maintained by the various offices and departments in county government. The documentation of differences in the quality of similar data bases will also allow county administrators, if they so chose, to select the better data base as the county standard.

Lastly, this study assists county administrators in devising a strategy for the implementation of a GIS for county government. This document will better assist administrators in determining interoffice data relationships to link the various data bases in a homogeneous and central county GIS system.

Future Implications -- The future implications of this research are significant. As the State of Kansas, through the Division of Information Systems and Communications, is seeking the implementation of a state wide GIS this study can aid this process in the documentation of information maintained and used by county level governments in the State of Kansas.

As the data bases maintained by county government are public documents, this study can aid citizen groups to better understand the interrelationship of data at the county level of government for needed information as it might relate to their needs presently and in a GIS environment.

GOALS AND OBJECTIVES

Goal of Research -- The goals of this research are to:

1) inventory present automated and manual spatial and attributive data bases used by officials in Riley County;
2) determine, whether GIS offers advantages over present information systems maintained in Riley County; and
3) and review how these various data bases might be better integrated in a GIS environment.

Research Objectives -- To achieve these goals specific objectives must be reached first:

1) There are a whole host of terms and concepts that must be defined to better understand the various meanings that shall be assigned to specific data bases. As the literature and professionals have agreed on little, even on just what constitutes a GIS, it is necessary to define terms in a clear and rudimentary way for a broad understanding of GIS in general and this document in particular.

2) There are specific hurdles that need understanding to better implement a GIS on the county level. The hurdles that must be overcome relate to the implementation process, political will, needed information files, useful applications and economic support. It will be necessary for this document to briefly summarize the experience and concerns of professionals in the field of GIS as they relate to these hurdles.

3) GIS in a Kansas context has a different imperative than in most other States. Usually, the support and drive for GIS is in its ability to better document environmental data and provide a superior tool in resource management. The drive or push for GIS in Kansas; however, is from the State mandated reappraisal. This is the open window that is being used by many counties and the state in particular to promote the use of GIS. Therefore, a brief discussion of what counties will gain from reappraisal and what reappraisal means in a GIS context is imperative to understand the underlining uses and applications a GIS can provide a county government.

4) Pertaining to the inventory of data bases 15 Riley County offices and departments have been interviewed to determine the maps (spatial data) that are produced, maintained or used by the office and department. Inventoried was map name, source, scale, number of sheets/sets, sheet size, base map/source, and major map features. Each office and department have also been interviewed to determine the data bases (attributive data) that are maintained and developed by the office or department. Inventoried was data base name, source, size, type of information, and typical use.

CHAPTER FOUR

Chapter Four is a compilation of nine sections, excluding this one. The purpose of these sections are to inventory existing spatial and attributive data bases maintained by various Riley County offices and departments. It serves to expound on how these data bases are used and to determine their compatibility and value in a GIS. This research is both descriptive and normative. Each section documents: the spatial and attributive data bases maintained by a department; determines how the data base is used; how the data base might fit into a GIS; and, when necessary, suggests modifications for the data to be better formatted for a GIS working environment.

The eight sections review specifically: (1) Riley County Appraiser, (2) Riley County Clerk and Treasurer, (3) Riley County Emergency Medical Service, (4) Riley County Engineer, (5) Riley County Noxious Weed Department, (6) Riley Count Road and Bridge Department, (7) Riley County Police Department, and (8) Riley County Planning and Zoning Department.

The ninth section reviews the information that will be obtained through the reappraisal process from Conley, Kight, and Eckford: Appraisal and Mapping Services.

The inventory of five offices and departments have been placed in the appendix. These offices have either a limited use of spatial data or do not use data directly, the Register of Deeds is a case in point.

These five departments are: (1) Riley County Attorney, (2) Community Corrections, (3) Riley County Health Department, (4) Riley County Personnel Department, and (5) Riley County Register of Deeds.

Each of these offices and departments have been inventoried to determine the maps (spatial data) that are produced by the office or department. Inventoried were map name, source, scale, number of sheets/sets, sheet size, base map/source, and major map features.

Each office or department was also asked to inventory the data bases (attributive data) that are maintained and used. Inventoried were data base name, source, size, type of information, and typical use. During the inventory of both the spatial and attributive data bases this survey also sought to determine typical use of the data.

RILEY COUNTY APPRAISER

The Riley County Appraiser determines the value of all personal and real property in Riley County. Sam Schanidt is the County Appraiser and was interviewed in obtaining the following information. As discussed in Chapter Four, the importance of this office in the distribution of information for a county wide GIS cannot be over stated. The following research is rather incomplete as the County Appraiser Office is in real and significant change as it implements new methods and data collection for appraisal. The following data bases then are somewhat incomplete as there are other data bases that are in the process of being developed and parameters are being determined as of this writing. This inventory documents only existing data bases and therefore, the reader should note that this is an incomplete list, because newer data bases are being developed and existing data bases are being altered. The research had two purposes: First, to inventory attributive and spatial data bases maintained or used by the department; and secondly to determine how day-to-day operations might benefit from a GIS.

INVENTORY:

During the inventory of attributive and spatial data bases it was determined that the Riley County Appraiser presently makes use of and maintains seven attributive data bases and four spatial data bases.

The attributive data bases are:

Map Work Card
Tax Roll
Real Estate Ownership Record (Redbook)
Oil Assessment Rendition
Commercial Property Return
Residential/Agricultural Return
Real Property Appraisal Card

The spatial data bases are:

Property Ownership Plat
Air Photos (KDR)
Air Photos (County Engineer)
USGS 7.5-Minute Maps

Specifically, these data bases are listed as the following:

Riley County Appraiser
Attribute Data Bases
Sam Schanidt
110 Courthouse Plaza, Manhattan: 537-6310

D/B NAME: Map Work Card
MAINTAINED BY: Appraiser & County Clerk
SOURCE: Conley, Kight, & Eckford (CKE)
SIZE: 20 000 (from tax roll)
TYPE OF INFO: (see below)
TYPICAL USE: for property reappraisal

Most of the information on this card is obtained from the County Clerk's "Red Book." The "map work card" includes

the following information: owner's name and mailing address, property address, county account or tract number, assessment roll description, updates, deed book and page, plotting explanation, mapping correlation, Kansas parcel number, subdivision code, property legal description, and lot size and acreage.

D/B NAME: Oil Assessment Rendition
MAINTAINED BY: Appraiser
SOURCE: Appraiser
SIZE: unknown
TYPE OF INFO: (see below)
TYPICAL USE: To determine tax assessment

The "oil assessment rendition" data base includes information on the owner, property legal description, well and lease data, itemized equipment list, oil production data, gross reserve calculations, and royalty interest.

D/B NAME: Commercial Property Return (Personal Property)
MAINTAINED BY: Appraiser
SOURCE: Appraiser
SIZE: Unknown
TYPE OF INFO: (see below)
TYPICAL USE: To determine personal property tax

The "commercial property return" data base includes name of taxpayer and address, classification of property and whether that property is a truck or trailer, bus, mobile home, or non-highway vehicle, camper, and any improvements on leased land, amount of grain handled, number of livestock, other miscellaneous vehicles, machinery, equipment and supplies, and leased equipment, construction equipment, merchants inventory,

manufacturer's inventory, and other tangible personal property.

D/B NAME: Residential/Agricultural Return (Personal Property)
MAINTAINED BY: Appraiser
SOURCE: Appraiser
SIZE: Unknown
TYPE OF INFO: (see below)
TYPICAL USE: To determine personal property tax

The "residential/agricultural return" data base includes name of taxpayer and address, classification of property and whether it is a truck or trailer, bus, mobile home, or non-highway vehicle, camper, any improvements on leased land, amount of grain handled, number of livestock, miscellaneous vehicles, machinery, and equipment.

D/B NAME: Real Estate Ownership Record (Redbook)
MAINTAINED BY: County Clerk
SOURCE: Register of Deeds
SIZE: approx. 20 000 parcels
TYPE OF INFO: parcel ownership
TYPICAL USE: historical record and property tax statements (Manual & Automated)

The "Real Estate Ownership Record" is a county wide record and includes: date of transfer of deed, type of deed, grantor's name, grantee's name, and book and page numbers. This data base is in three formats: by chronological order, by alphabetical order, and by street or location.

D/B NAME: Tax Roll
MAINTAINED BY: County Clerk
SOURCE: County Clerk
SIZE: approx. 20 000 parcels
TYPE OF INFO: (see below)
TYPICAL USE: for tax statements
(Manual & Automated)

The "tax roll" includes the following data: name and address of taxpayer, legal description of taxable land, tract number, tax unit, value, mill levy, general tax, applicable specials, total tax, half tax, and delinquent tax.

D/B NAME: Real Property Appraisal Card
MAINTAINED BY: County Appraiser
SOURCE: County Appraiser
SIZE: approx. 20 000 cards
TYPE OF INFO: (see below)
TYPICAL USE: To determine assessed property tax

Each appraisal card is anchored to an individual land parcel. Information on the owner is given and so is a legal description, building permit record, neighborhood data, description of the site, estimated land value, estimated value by market data approach, estimated value of other buildings or additions, type of building construction, estimated value by cost approach, and estimated value by income approach. There is space available for a sketch of the property boundary and placement of structure footprints.

Riley County Appraiser
Spatial Data Bases
Sam Schanidt
110 Courthouse Plaza, Manhattan: 537-6310

MAP NAME: Property Ownership Plat
MAINTAINED BY: Appraiser
SCALE: 166 @ 1:100, 20 @ 1:200, & 175 @ 1:400
NO. SHEETS/SET: see scale
SHEET SIZE: varies
BASE MAP/SOURCE: varies/Conley, Kight, & Eckford

The "property ownership plat" documents ownership parcels and right of ways. The Manhattan Urban Area is drafted at 1:100 scale. The southern part of the county is drafted at 1:200 scale. Rural townships north of Manhattan are drafted at 1:400 scale. The "map work card" is used to draft these drawings.

MAP NAME: Air Photo
MAINTAINED BY: KS Department of Revenue
SCALE: Altitude varies scale most @ 1:400 and 1:100
NO. SHEETS/SET: 175 sheets/one (1) set
SHEET SIZE: varies
BASE MAP/SOURCE: KS Department of Revenue/KS Department of Revenue

This is a county wide non-vegetation air photo taken between 10 am & 2 pm during the winter months.

MAP NAME: Air Photo
MAINTAINED BY: County Engineer
SCALE: 1:10 scale
NO. SHEETS/SET: Unknown
SHEET SIZE: 18 X 18"
BASE MAP/SOURCE: County Engineer/County Engineer

The 1:10 "air photo" is used to help decide boundary disputes and measure the acreage of a parcel for an individual.

MAP NAME: USGS 7.5-Minute Maps
MAINTAINED BY: US Geological Survey (USGS)
SCALE: 1:24 000
NO. SHEETS/SET: 20 sheets per set for County
SHEET SIZE: 22 X 28"
BASE MAP/SOURCE: USGS/USGS

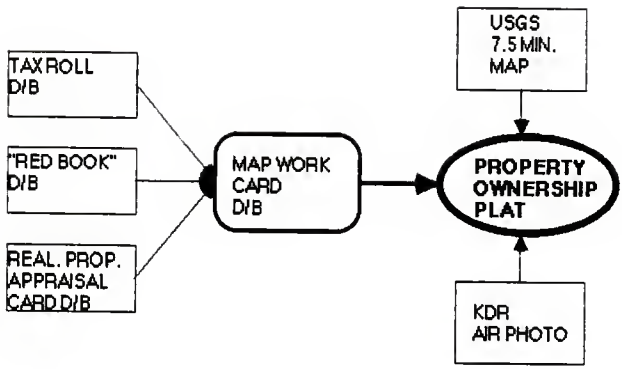
The county appraiser uses 7.5-minute map to locate section lines and to determine various errors during surveys. The USGS 7.5 minute map features contour lines, streams, natural lakes and ponds, man made lakes and reservoirs, canals, aqueducts, and ditches, roads and railroads, bridges, buildings and urban areas, pipelines, power transmission lines, airway facilities, oil and gas fields, industrial plant areas, cemeteries and graves, recreational areas, historical landmarks, open-pit mines and quarries, and vegetation.

SPATIAL DATA FLOW CHARTS:

To understand how these various attributive data bases are used in conjunction with spatial data bases; it is necessary to identify the interdependence and inter-relationship of the documents.

This research does not seek to determine the effectiveness and efficiency the Riley County Appraisers Office performs its job. Rather, it is the researchers task to inventory existing data bases and determine how they might better be applied in a GIS environment.

The Property Ownership Plat as it is being processed has three direct relationships with two spatial data bases and on attributive data base. The Map Work Card is a compilation of information found in the Tax Roll, "Red Book," and Real Property Appraisal Card. As a property legal description is obtained in Map Work Card, the Property Ownership Plat bases much of its data from this descriptive data. To aid in the drafting of this data, the KDR Air Photos are used as a base in drawing streets and building footprints on the Property Ownership Plat. The topography of the land is transferred from the USGS 7.5 Minute Maps. The following Figure demonstrates the relationship of these various attributive and spatial data bases.



PROPERTY OWNERSHIP PLAT
FIGURE - 6

ATTRIBUTIVE DATA FLOW CHARTS:

In review of the various attributive data bases, as they pertain to the Riley County Appraiser Office, it appears there would be little gained in restating the attributive data uses in preparing the Property Ownership Plat. Of the two remaining attributive data bases maintained or used by the county Appraiser, it is clear that these both--Commercial Property Return and Residential/Agricultural Return--document property for personal property tax. Since personal property is relatively easily transported and subject to sales transfer, there is little gained in utilizing this data in a GIS.

RILEY COUNTY APPRAISER CONCLUSION:

What has been shown; thus far, as pertains to the Riley County Appraiser, has been existing attributive and spatial data bases; how such data bases are presently used; and how they might be better used in a GIS environment. This is the end of the scope of this research. What is left to be determined is what additional data files would be of benefit to the County Appraiser that are not presently consulted or collected. There are other possible avenues of study that need further research to determine the full potential of GIS. Two examples are soil information and the use of this data for economic studies. The use of GIS in property tax assessment has great potential for further study.

RILEY COUNTY CLERK AND TREASURER

The Riley County Clerk and County Treasurer are discussed jointly in this section as they are both inter-dependent for the information they maintain and use. Though the County Clerk assesses property tax, after the value is appraised by the County Appraiser and the Clerk indicates the tax to be collected this data is passed onto the County Treasurer. There is no real need for the exact specifications in the form of a spatial data base to be given to the County Clerk or the County Treasurer on a day-to-day basis. The use of maps these two offices make are mainly for citizen information purposes that relate to comparatively static city and county maps. For example, once a political boundary is established; it is rather unlikely that it will be changed in the foreseeable future. Information relating to tax statements is the primary need for these two offices. Therefore, this section will only document the various attributive and spatial data bases used by these two offices; but will forgo any detailed discussion or evaluation as they relate to GIS technology.

INVENTORY:

During the inventory of attributive and spatial data bases it was determined that the County Clerk presently makes use of and maintains six attributive data bases and five spatial data bases.

The attributive data bases are:

Tax Roll
Special Assessment for the City of Manhattan
Riley County Sewer District Specials
Real Estate Ownership Record
Real Property Appraisal Card
Voter Registration Report

The spatial data bases are:

Manhattan City Official Base Map
Riley County Property Ownership Map
Township Boundary Map
Manhattan Voting Wards - Precincts Map
County Section Map

Specifically, these data bases are listed as the following:

Riley County Clerk
Attribute Data Bases
Wanda Coder
110 Courthouse Plaza, Manhattan: 537-6300

D/B NAME: Tax Roll
MAINTAINED BY: County Clerk
SOURCE: County Clerk
SIZE: approx. 20 000 parcels
TYPE OF INFO: (see below)
TYPICAL USE: for tax statements
(Manual & Automated)

The "tax roll" includes the following data: name and address of taxpayer, legal description of taxable land, tract number, tax unit, value, mill levy, general tax, applicable specials, total tax, half tax, and delinquent tax.

D/B NAME: Special Assessment for the City of Manhattan
MAINTAINED BY: City of Manhattan
SOURCE: City of Manhattan
SIZE: approx. 3 000
TYPE OF INFO: (see below)
TYPICAL USE: tax purposes
(Manual & Automated)

There are two main specials in the City of Manhattan: street paving and sewer. The information included in the "special assessment for the City of Manhattan" data base is: owner name, address, identification number, principal owed and interest owed for the years present tax statement.

D/B NAME: Riley County Sewer District Specials
MAINTAINED BY: County Clerk
SOURCE: County Clerk
SIZE: approx. 1 000
TYPE OF INFO: (see below)
TYPICAL USE: to tax sewer specials
(Manual & Automated)

Information in the "Riley County Sewer District Specials" data base is: name and address of owner, legal description of land, tract number, project description, payoff date, per year amount owed including principle and interest totals for present tax statement.

D/B NAME: Real Estate Ownership Record (Redbook)
MAINTAINED BY: County Clerk
SOURCE: Register of Deeds
SIZE: approx. 20 000 parcels
TYPE OF INFO: parcel ownership
TYPICAL USE: historical record and property tax statements (Manual & Automated)

The "Real Estate Ownership Record" is a county wide record and includes: date of transfer of deed, type of deed, grantor's name, grantee's name, and book and page numbers. This data base is in three formats: by chronological order, by alphabetical order, and by street or location.

D/B NAME: Real Property Appraisal Card
MAINTAINED BY: County Appraiser
SOURCE: County Clerk, Reg. of Deeds, and Plan. & Zoning
SIZE: approx. 20 000 cards
TYPE OF INFO: (see below)
TYPICAL USE: To determine assessed property tax value (Manual)

Each appraisal card is anchored to an individual land parcel. Information on the owner is given and so is a legal description, building permit record, neighborhood data, description of site, estimated land value, estimated value by market data approach, estimated value of other buildings or additions, type of building construction and estimated value by cost approach, and estimated value by income approach. There is space available for a sketch of the property boundary and drawing of structure footprints.

D/B NAME: Voter Registration Report
MAINTAINED BY: County Clerk
SOURCE: County Clerk
SIZE: 17 291 persons as of 16 Feb. 1988
TYPE OF INFO: (see below)
TYPICAL USE: for elections
(automated)

The "Voter Registration Report" includes the following information: voters name & address, political party, ward, precinct, school district, and voting record.

Riley County Clerk
Spatial Data Bases
Wanda Coder
110 Courthouse Plaza, Manhattan: 537-6300

MAP NAME: Manhattan City Official Base Map
MAINTAINED BY: Manhattan City
SCALE: unknown
NO. SHEETS/SET: one/one
SHEET SIZE: 5 1/2' X 6'
BASE MAP/SOURCE: Manhattan City/Manhattan City

The "Manhattan City Official Base Map" is used to identify tracks of land and for locating land parcels.

MAP NAME: Riley County Property Ownership Map
MAINTAINED BY: Charlson & Wilson
SCALE: 1" = 1 mile
NO. SHEETS/SET: one (1)
SHEET SIZE: 3' X 3 1/2'
BASE MAP/SOURCE: Charlson & Wilson/Charlson & Wilson

The "Riley County Property Ownership Map" lists all noncity property parcels and the owners name. This map is used to confirm section, township, range and to locate what township taxpayer is in. It is also used to cross reference with data being collected.

MAP NAME: Township Boundary Map
MAINTAINED BY: County Clerk
SCALE: 1/2" = 1 mile
NO. SHEETS/SET: one/one
SHEET SIZE: 18 X 21"
BASE MAP/SOURCE: General Highway Map/KS Department of Transportation

The "Township Boundary Map" is used to assist citizens in determining which township they reside.

MAP NAME: Manhattan Voting Wards - Precincts Map
MAINTAINED BY: Manhattan City
SCALE: 1 1/2" = 1/2 mile
NO. SHEETS/SET: one/one
SHEET SIZE: 19 x 25"
BASE MAP/SOURCE: Manhattan Voting W- P Map/Riley County Clerk

This map is used to confirm what ward a taxpayer from the City of Manhattan lives in and to determine if there

are any specials. The "Manhattan Voting W - P Map" is used to cross reference with data being collected.

MAP NAME: County Section Maps
MAINTAINED BY: County Engineer
SCALE: 1:400 & 1:200
NO. SHEETS/SET: 516 sheets total/6 sets
SHEET SIZE: 17 x 18"
BASE MAP/SOURCE: County Section Maps/County Engineer's Office

The "County Section Maps" features section ownership plats. This series of maps are used to resolve any questions for landowners dealing with property legal descriptions.

During the inventory of attributive and spatial data bases it was determined that the County Clerk presently makes use of and maintains two attributive data bases and two spatial data bases.

The attributive data bases are:

Tax Roll
Public Utilities Real Property Tax Roll

The spatial data bases are:

Riley County Property Ownership Map
Manhattan Voting Wards - Precincts Map

Specifically, these data bases are listed as the following:

Riley County Treasurer
Attributive Data Bases
Eileen King
110 Courthouse, Manhattan: 537-6320

D/B NAME: Riley County Real Property Tax Roll
MAINTAINED BY: Treasurer
SOURCE: County Appraiser & County Clerk
SIZE: approx. 35 000 to 40 000 tax statements per year
TYPE OF INFO: (see below)
TYPICAL USE: tax collection
(Automated)

The real property tax roll is used to distribute tax statements. Real property tax is calculated from property owned on the 1st of January. The tax statement includes the following information: name, address, brief property legal description, track number, property valuation, total levy, total general tax, city specials, county specials, total tax, half-tax payment, and tax unit. The real property tax roll is also used to determine delinquent taxes for publication and notification purposes.

D/B NAME: Riley County Public Utilities Real Property Tax Roll
MAINTAINED BY: Treasurer
SOURCE: County Appraiser & County Clerk
SIZE: 30 public utilities
TYPE OF INFO: (see below)
TYPICAL USE: tax collection
(Automated)

The "Public Utilities Real Property Tax Roll" contains essential the same information as the "Riley County Real Property Tax Roll." It is maintained as a separate data base

because public utility may cross several township boundaries, thus serving a separate bookkeeping function.

Riley County Treasurer
Spatial Data Bases
Eileen King
110 Courthouse, Manhattan: 537-6320

MAP NAME: Riley County Property Ownership Map
MAINTAINED BY: Charlson & Wilson
SCALE: 1" = 1 mile
NO. SHEETS/SET: one (1)
SHEET SIZE: 3' X 3 1/2'
BASE MAP/SOURCE: Charlson & Wilson

The "Property Ownership Map" lists all non-city property parcels and includes the owner(s) name. The ownership map is used to confirm section, township, range and to find what township various tax payers reside. This map is also used in cross referencing with data collection.

MAP NAME: Manhattan Voting Wards - Precincts Map
MAINTAINED BY: Manhattan City
SCALE: 1 1/2" = 1/2 mile
NO. SHEETS/SET: one (1)
SHEET SIZE: 19 x 25"
BASE MAP/SOURCE: Manhattan Voting Wards - Precincts Map/Riley County Clerk

The "Manhattan Voting Wards - Precincts Map" is used to confirm which ward a tax payer resides in, and to determine if there are any specials that apply to an

individuals tax statement. This map is also used as across referencing with data collection.

RILEY COUNTY CLERK AND COUNTY TREASURER CONCLUSION:

Again, since the duties and responsibilities of these two county offices, for day-to-day activities, rely on information provided by the County Appraiser. Any spatial data analysis or use is performed by the County Appraiser and only the descriptive data is used by these two offices. Though this data could be transferred through a GIS, it is not an attribute or benefit such systems normally provide.

RILEY COUNTY EMERGENCY MEDICAL SERVICE

The Riley County Emergency Medical Service's (EMS) director is Dan Morabito. Perry Rankin, EMS Crew Chief, was suggested by Morabito as the person that should be interviewed to determine EMS's use of spatial and attributive data. This research had two purposes: First, to inventory attributive and spatial data bases maintained and used by the department; and secondly to determine how day-to-day operations might benefit from a GIS.

"EMS" is the sole provider of ambulance and paramedic emergency response services in Riley County. EMS is on call 24 hours a day and in little as a minutes time an emergency vehicle can depart the EMS Center and be off towards its destination. Time is critical, as often a life is in the balance. EMS has developed a well organized mapping system for locating an address anywhere in the county. After having seen this system put into effect as a paramedic team raced off to respond to a child who had been hit by an automobile it is a rather sobering task to even contemplate changes. Fortunately, this is a task that is nether the intent nor the purpose of this study. To be determined here is the documentation of specific data bases and maps that are shared by EMS with other county offices and departments.

INVENTORY:

During the inventory of attributive and spatial data bases it was determined that EMS presently makes use of and maintains three

attributive data bases and six spatial data bases. As EMS is concerned with the location of addresses in Riley and part of Pottawatomie counties, there is little else the researcher is able to determine that would be of value in a GIS for EMS. GIS is not a geo-positioning system that can give real time data.

The attributive data bases are:

Run Log Book
EMS Map Book "Riley County Street Name List"
EMS Map Book "Riley County Area Hospital List"

The spatial data bases are:

EMS Map Book "Manhattan City Section"
EMS Map Book "County Area Specific Maps"
Riley County Street Map (Map of Riley County)
Riley County Index Map
Manhattan City Street Map
Pottawatomie Township Map

Specifically, these data bases are listed as the following:

Riley County Emergency Medical Service (EMS)
Attributive Data Bases
Perry Rankin
2011 Claflin Rd., Manhattan: 539-3535

D/B NAME: Run Log Book
MAINTAINED BY: EMS
SOURCE: EMS
SIZE: unknown
TYPE OF INFO: (see below)
TYPICAL USE: documentation

All emergency and non-emergency responses are logged in the "Run Log." The "Run Log" documents: run number, patient name, place picked up and hospital taken to, time of initial call, time call received by EMS, time crew departed EMS Center, time on scene, time crew leaves scene, time crew arrives at hospital, time crew leaves hospital to return to EMS Center, name of dispatch service that called EMS, name of crew members who took the run, and total EMS cost for the run.

D/B NAME: EMS Map Book "Riley County Street Name List"
MAINTAINED BY: EMS
SOURCE: Planning & Zoning
SIZE: 337 Streets
TYPE OF INFO: (see below)
TYPICAL USE: street location

The "Riley County Street Name List" is placed at the front of the "EMS Map Book" and is used to find a location map of the emergency scene. Included in the list is: all street names in Riley County, page a map can be found on,

general area street located in, and address number range of street.

D/B NAME: EMS Map Book "Riley County Area Hospital List"
MAINTAINED BY: EMS
SOURCE: EMS
SIZE: 21 hospitals
TYPE OF INFO: (see below)
TYPICAL USE: hospital location

As an adjunct to the "Street Name List" in the "EMS Map Book," the "Area Hospital List" section contains information on area hospitals with directions to each of the 21 hospitals and their type of communication system uses (radio frequency or phone number). Specifically, the information included in this list is: city hospital is in, hospital name, directions to hospital from EMS Center, radio frequency hospital monitors, and phone number.

Riley County Emergency Medical Service (EMS)
Spatial Data Bases
Perry Rankin
2011 Claflin Rd., Manhattan: 539-3535

MAP NAME: EMS Map Book "Manhattan City Section"
MAINTAINED BY: EMS
SCALE: not to scale
NO. SHEETS/SET: 46 sheets
SHEET SIZE: 8.5 X 11"
BASE MAP/SOURCE: EMS

This part of the "Map Book" includes a layout of major apartment and mobile home complex within the City of Manhattan and the surrounding area. Information contained for each complex is: apartment or mobile home lot numbers,

street layout, complex position to road, north arrow, and text that gives the direction to a particular complex from the EMS Center.

MAP NAME: EMS Map Book "County Area Specific Maps"
MAINTAINED BY: EMS
SCALE: 1" = 1/2 mile
NO. SHEETS/SET: 23
SHEET SIZE: 8.5 x 11"
BASE MAP/SOURCE: Map of Riley County/County Engineer

The "Area Specific Maps" are traced from the "Riley County Street Map." These maps have been traced to a manageable size for placement in the "EMS Map Book"

MAP NAME: Riley County Street Map (Map of Riley County)
MAINTAINED BY: EMS
SCALE: 1" = 1/2 mile
NO. SHEETS/SET: 2 sheets per set (both sides of one sheet)
SHEET SIZE: 34 x 36"
BASE MAP/SOURCE: Map of Riley County/County Engineer

The "Street Map" serves as a wall map in the dispatch center to determine area location and any road name changes. It is used for 911 street name requirements and for finding the location of sites.

MAP NAME: Riley County Index Map
MAINTAINED BY: EMS
SCALE: 1/2" = 1 mile
NO. SHEETS/SET: one (1)
SHEET SIZE: 18 1/2 x 30"
BASE MAP/SOURCE: General Highway Map/Kansas Department of Transportation

The "Index Map" serves as an index to locate 23 area specific maps in the "EMS Map Book" and provides page numbers of those maps. This map is laminated on a clear plastic sheet and is used in the dispatch center and is carried on board each vehicle.

MAP NAME: Manhattan City Street Map
MAINTAINED BY: Manhattan Chamber of Commerce
SCALE: 3.5 centimeters = 1 mile (metric scale)
NO. SHEETS/SET: 1/1
SHEET SIZE: 16 X 22"
BASE MAP/SOURCE: Manhattan City Street Map/Manhattan Chamber of Commerce

The "Manhattan City Street Map" lists all streets within the city and uses a grid system for street location. This map is laminated on a clear plastic sheet and is used in the dispatch center and carried on board each vehicle.

MAP NAME: Pottawatomie Township Map
MAINTAINED BY: EMS
SCALE: varies (photo copy)
NO. SHEETS/SET: 23
SHEET SIZE: 14 X 17"
BASE MAP/SOURCE: Township Plat/Pottawatomie County Planner

Riley County responds mainly to Blue Township in Pottawatomie County. Since a part of Pottawatomie is in the South Western Bell 911 exchange system, Riley County EMS has been designated to respond to 911 calls in the area. The map serves as a means to locate addressees and street names in Pottawatomie County. This book is at present used only in the EMS dispatch center.

SPATIAL DATA FLOW CHARTS:

The above actually documents the use of two attributive data bases in conjunction with three spatial data bases creating a single data base. The EMS Map Book is the primary document used and is a four section book. As shown above these are the: Riley County Street Name List; Manhattan City Section; Riley County Area Hospital List; and the County Area Specific Maps. Used in conjunction with the EMS Map Book are the Riley County Index Map and the Manhattan City Street Map. To avoid confusion, EMS dispatch works with the same maps onboard the emergency vehicles. Therefore, the Riley County Street Map and the Pottawatomie Township Map receive little use. Least there be too great of concern, presently it is the task of Rankin to create two additional sections in the EMS Map Book that will include

a Pottawatomie County Street List and a Pottawatomie County Township Road Map. Yet, at present EMS has no street names for Pottawatomie County the set of maps they do have available are woefully negligent in lacking a complete list of street names. As the 911 system identifies a callers location by street name and number, it is not a fortuitous situation to be in need of a fast response in Pottawatomie County.

Returning to the GIS asspect of this study it is apparent that the maps used by EMS are of a commercial and non-commercial quality and lack current and detailed information. The commercial maps are highly detailed but because of street name changes and new developments the information is about a year or two out of date. While the non-commercial maps are current, they lack scale and detail. It is asserted that the benefit of a GIS is its capability of producing high quality and current maps for insertion into the EMS Map Book, as the present relationship to both spatial and attributive data appears more than adequate.

ATTRIBUTIVE DATA FLOW CHARTS:

Since it has been shown that the EMS has already linked their attributive data with spatial data, there is little value to be obtained from asserting the various benefits such a system can and does achieve. Such a discussion would be only redundant to the above section. As an aside, noticeable lacking in EMS's data bases is the 911 emergency response system. This is because the Riley County Police

Department (RCPD), with patrol cars already in the field, has an even faster response time than EMS (see RCPD section).

EMERGENCY MEDICAL SERVICE CONCLUSION:

What has been shown; thus far, as GIS pertains to the Emergency Medical Service, has been existing attributive and spatial data bases; how such data bases are presently used; and how they might be better improved in a GIS environment. EMS has demonstrated, in a manual format, how a GIS can aid EMS in map generation.

RILEY COUNTY ENGINEER

The Riley County Engineer is a responsible for not only the duties as the County Engineer; but is also the head of the Road and Bridge Department. As these responsiblities are viewed by Dan Handen as separate duties, the specific data bases used are treated separately and shall receive distinct treatment in this document. Therefore, the information uses for Road and Bridge have been treated in a separate section. After some lengthy discussion with Handen, it was determined that, as County Engineer, his office maintains no "significant" attributive data bases per se but maintains a wealth of spatial data bases or maps. The research had two purposes: First, to inventory attributive and spatial data bases maintained or used by the department; and secondly to determine how day-to-day operations might benefit from a GIS. Since the County Engineer maintains no attributive data bases, this section will focus only on the spatial data bases.

INVENTORY:

During the inventory of data bases it was determined that the Riley County Engineer presently makes use of and maintains thirteen spatial data bases.

The spatial data bases are:

Original Right of Way Record
Air Photo (County Engineer)
USGS 7.5-Minute Maps
Air Photo (KDR)
County Section Maps
Official Zoning Maps
Flood Plain Maps
Original Federal Land Survey
Riley County Street Map
General Highway Map
Highway and Bridge Plans
Riley County Soil Survey
Construction Materials Inventory of Riley County

Specifically, these data bases are listed as the following:

Riley County Engineer
Spatial Data Bases
Dan Handen
110 Courthouse Plaza, Manhattan: 537-6330

D/B NAME: Original Right of Way Record
MAINTAINED BY: County Engineer
SOURCE: original County Surveyor
SIZE: unknown
TYPE OF INFO: road right of ways
TYPICAL USE: historical document

The "Original Right of Way Record" dates from the 1850's and1860's. In this record the information described is the person asking for the right of way, property legal descriptions, and width of right of way. This record is written with illustrations.

MAP NAME: Original Right of Way Record
MAINTAINED BY: County Engineer
SCALE: varies
NO. SHEETS/SET: unknown
SHEET SIZE: varies
BASE MAP/SOURCE: Original County Surveyor

The "Original Right of Way Record" dates from the 1850's and1860's. In this record the information described is the person asking for the right of way, property legal descriptions, and width of right of way. This record is written with illustrations. This is primarily a historical document.

MAP NAME: Air Photo
MAINTAINED BY: KS Department of Revenue
SCALE: altitude varies scale most @ 1:400 and 1:100
NO. SHEETS/SET: 175 sheets total
SHEET SIZE: varies depending on size of enlargement
BASE MAP/SOURCE: KS Department of Revenue/KS Department of Revenue

This is a non-vegetation "air photo" taken between 10 am & 2 pm during the winter months of 1986-87.

MAP NAME: USGS 7.5-Minute Maps
MAINTAINED BY: US Geological Survey (USGS)
SCALE: 1:24 000
NO. SHEETS/SET: 20 sheets per set for County
SHEET SIZE: 22 X 28"
BASE MAP/SOURCE: USGS/USGS

The county appraiser uses 7.5-minute map to locate section lines and to determine various errors during surveys. The USGS 7.5 minute map features contour lines, streams, natural lakes and ponds, manmade lakes and reservoirs, canals, aqueducts, and ditches, roads and railroads, bridges, buildings and urban areas, pipelines, power transmission lines, airway facilities, oil and gas fields, industrial plant areas, cemeteries and graves, recreational areas, historical landmarks, open-pit mines and quarries, and vegetation.

MAP NAME: Air Photo
MAINTAINED BY: County Engineer
SCALE: 1:10 scale
NO. SHEETS/SET: Unknown
SHEET SIZE: 18 X 18"
BASE MAP/SOURCE: County Engineer/County Engineer

These air photos are used to decide questions of boundary disputes and acreage of a parcel and to determine stream migration.

MAP NAME: County Section Maps
MAINTAINED BY: County Engineer
SCALE: 1:400 & 1:200
NO. SHEETS/SET: 516 sheets total/6 sets
SHEET SIZE: 17 x 18"

BASE MAP/SOURCE: County Section Maps/County Engineer's Office

The "County Section Maps" features section ownership plats. This series of maps are used to resolve any questions for landowners dealing with property legal descriptions.

MAP NAME: Official Zoning Maps
MAINTAINED BY: Planning & Zoning
SCALE: 1:400 & 1:200
NO. SHEETS/SET: 516 sheets total/6 sets
SHEET SIZE: 17 x 18"
BASE MAP/SOURCE: County Section Maps/County Engineer's Office

The "Official Zoning Maps" feature section ownership plats. This map lists residential, multi-family, commercial, industrial, flood plain, university development, agriculture, airport noise hazard district, PUD-residential, PUD-commercial, PUD-industrial, conditional use, variance, and Manhattan City limits.

MAP NAME: Flood Plain Maps
MAINTAINED BY: Federal Emergency Management Agency (FEMA)
SCALE: varies
NO. SHEETS/SET: 16 sheets/one set
SHEET SIZE: varies
BASE MAP/SOURCE: FEMA/FEMA

The County Engineer holds only those FEMA flood plain maps that are for unincorporated areas.

MAP NAME: Original Federal Land Survey
MAINTAINED BY: County Engineer
SCALE: varies
NO. SHEETS/SET: unknown
SHEET SIZE: varies
BASE MAP/SOURCE: original surveyor/original surveyor

The "Original Federal Land Survey" is used for historical documentation.

MAP NAME: Riley County Street Map (Map of Riley County)
MAINTAINED BY: Planning & Zoning
SCALE: 1" = 1/2 mile
NO. SHEETS/SET: 2 sheets per set (both sides of one sheet)
SHEET SIZE: 34 x 36"
BASE MAP/SOURCE: Map of Riley County/Planning&Zoning

The "Street Map" serves as a wall map to work on road name changes. Is used for 911 street name requirements. And for finding the location of sites.

MAP NAME: General Highway Map
MAINTAINED BY: Kansas Department of Transportation
SCALE: 1/2" = 1 mile
NO. SHEETS/SET: one (1)
SHEET SIZE: 18 1/2 x 30"
BASE MAP/SOURCE: General Highway Map/Kansas Department of Transportation

The "General Highway Map" is a county wide map showing: roads and roadway features, road system designations, railroads, railroad crossings, city and village centers, conservation and recreation sites, boundaries,

structures, bridges, farm units, dwellings (in use & not in use), educational and correctional institutions, public service facilities, natural features, industrial sites, navigable streams, drainage, and airways and airports.

MAP NAME: Highway and Bridge Plans
MAINTAINED BY: County Engineer
SCALE: varies
NO. SHEETS/SET: 324 plans total
SHEET SIZE: varies
BASE MAP/SOURCE: varies/varies

When federal money is spent on a bridge or road project in Riley County; whether state, county, or city, all plans of construction must be maintained by the County Engineer.

MAP NAME: Riley County Soil Survey
MAINTAINED BY: USDA, Soil Conservation Service
SCALE: 1:24 000
NO. SHEETS/SET: 40 sheets per set
SHEET SIZE: 11 x 17"
BASE MAP/SOURCE: Soil Survey/USDA Soil Conservation Service

The "Soil Survey of Riley County" contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, or other structures; and in appraising the suitability of tracts of land for farming, industry, or recreation.

MAP NAME: Construction Materials Inventory of Riley County No. 35.
MAINTAINED BY: Kansas Department of Transportation (KDOT)
SCALE: 1" = 1 mile
NO. SHEETS/SET: 12 per set/one set
SHEET SIZE: 11 X 17"
BASE MAP/SOURCE: KDOT/KDOT

This "Inventory" is contained in a 95 page booklet distributed by KDOT. It offers a general assessment of geological conditions in Riley County. This inventory is written in text and includes illustrations and maps.

RILEY COUNTY ENGINEER CONCLUSION:

The Office of County Engineer posses a difficult dilemma in determining the "uses" that a GIS might be applied to in the fulfillment of duties and responsibilities. This research does not seek to determine the effectiveness and efficiency the Riley County Engineer Office performs its job. Rather, it is the researchers task to inventory existing data bases and determine how they might better be applied in a GIS environment. The author is impressed with the idea that this office is the "keeper of information" but directly puts little of it to use, separate from the Road and Bridge Department. Even if the Road and Bridge responsibilities were taken into consideration, as much of the design and construction of roads and bridges are performed by out-side contractors, the data is still put to little direct use by the County Engineer. Obviously, this data is put to some practical use, or it would not be maintained. Most of the aforementioned spatial data bases in this section were of value to at

least six of the offices and departments inventoried. Being so perplexed, the researcher is left with only one clear conclusion, that these various spatial data bases, though no suggested use will be made, are of the caliber that is ideal for separate spatial and attributive data base files in a GIS.

RILEY COUNTY NOXIOUS WEED DEPARTMENT

The Riley County Noxious Weed Department's (NWD) director is Dennis Peterson. Peterson was interviewed to determine the use of spatial and attributive data and present practices at the Noxious Weed Department. This research had two purposes: First, to inventory attributive and spatial data bases maintained or used by the department; and secondly to determine how day-to-day operations might benefit from a GIS.

"NWD" is responsible for the control of all noxious weeds in Riley County. There are three noxious weeds, as defined by state statues, in Riley County: Musk Thistle, Bindweed, and Johnson Grass. NWD sprays along all roads and right-of-ways in the county. A large part of NWD efforts to eradicate these three weeds are performed by private property owners. State statues require that property owners spray for noxious weeds. To assist property owners and defray chemical cost, NWD purchases herbicides in bulk shipments and sells these chemicals at cost minus twenty-five percent [public cost = (wholesale cost - 25% of wholesale cost)]. As a result of these sales, a significant part of NWD work is to supervise spraying and document what specific acres of private and public owned land has been sprayed. Should a property owner not spray for noxious weed infestation it is the responsibility of NWD to spray.

INVENTORY:

During the inventory of attributive and spatial data bases it was determined that NWD presently makes use of and maintains five attributive data bases and ten spatial data bases. As NWD is concerned with the distribution and acreage of sprayed, it has in a since maintained a GIS in a manual data processing environment. Peterson has demonstrated, in manual form, the value and utility of a GIS.

The attributive data bases are:

Form 19R
Form 19RY
Noxious Weed Infestation Complaint Sheet
Noxious Weed Complaint File
Riley County Tax Roll

The spatial data bases are:

Non Spray Areas Map
General Highway Map
Riley County Stop Sign Location Map
Riley County Musk Thislle Bowhevel Migration Map
Riley County Owner Not Sprayed Map
Musk Thislle Treatment 1987
Bindweed & Johnson Grass Treatment 1987
Section & Ownership Map
Air Photos (County Engineer)
Riley County Rural Phone Directory

Specifically, these data bases are listed as the following:

Riley County Noxious Weed Department
Attributive Data Bases
Dennis Peterson
2711 Anderson Ave., Manhattan: 539-3202

D/B NAME: Form 19R
MAINTAINED BY: Noxious Weed Department
SOURCE: Noxious Weed Department
SIZE: all chemical sales
TYPICAL USE: documents chemical sales for noxious weeds and for tracking parcels sprayed

"Form 19R" contains information for the following: date, county, township, owner's name, operator's name, section and range of land area sprayed, rate of application (chemical per acre), amount purchased, price, chemical (trade name and manufacturer's name), chemical cost, noxious weed treated, chemical batch number, and EPA registration number.

D/B NAME: Form 19RY
MAINTAINED BY: Noxious Weed Department
SOURCE: Noxious Weed Department
SIZE: all requested sprays
TYPE OF INFO: documents chemical sprays by county for noxious weeds
TYPICAL USE: documentation and for tracking parcels sprayed

"Form 19RY" is used for the same purpose as Form 19 but it specifies method of treatment, amount of vegetation, land use, soil type, and weather condition on day(s) sprayed. This form is used when an owner requests the Noxious Weed Department to spray their land or if the Noxious Weed

Department must take action due to the failure or refusal of a landowner to spray for noxious weeds.

D/B NAME: Noxious Weed Infestation Complaint Sheet
MAINTAINED BY: Noxious Weed Department
SOURCE: Noxious Weed Department
SIZE: lists all complaints
TYPE OF INFO: (see below)
TYPICAL USE: documentation of confirmed noxious weed infestation

This "Complaint Sheet" data base documents: owner's name, address, phone number, operator's name, address, phone number, date contacted, type of notice given, place given, statement of notice, response, date site is inspected, type of noxious weed, acres covered, legal description of parcel, and photo slide number.

D/B NAME: Noxious Weed Complaint File
MAINTAINED BY: Noxious Weed Department
SOURCE: Noxious Weed Department
SIZE: 40 to 50 per year
TYPE OF INFO: (see below)
TYPICAL USE: to document complaints

The "Noxious Weed Complaint File" documents all complaints, whether substantiated or not. Includes complainants name, address, and phone number, also the offenders, address phone number, noxious weed described, legal description of land, acres covered, herbicide used, amount used, and there is space for field notes.

D/B NAME: Tax Roll
MAINTAINED BY: County Clerk
SOURCE: County Clerk
SIZE: approx. 20 000 parcels
TYPE OF INFO: (see below)
TYPICAL USE: (see below)
(Manual & Automated)

The "tax roll" includes the following data: name and address of taxpayer, legal description of taxable land, tract number, tax unit, value, mill levy, general tax, applicable specials, total tax, half tax, and delinquent tax. The "Tax Roll" is used by NWD to identify property owners and property owned by adjacent land owners.

Riley County Noxious Weed Department
Spatial Data Bases
Dennis Peterson
2711 Anderson Ave., Manhattan: 539-3202

MAP NAME: Non Spray Areas Map
MAINTAINED BY: Noxious Weed Department
SCALE: Unknown
NO. SHEETS/SET: Unknown
SHEET SIZE: Unknown
BASE MAP/SOURCE: Central Publishing Company/Central Publishing Company

The "Non Spray Areas Map" is used to remind crews where they are not to spray herbicides for various reasons, such as apple groves, crops, and elderly housing.

MAP NAME: General Highway Map
MAINTAINED BY: Kansas Department of Transportation
SCALE: 1/2" = 1 mile
NO. SHEETS/SET: one (1)
SHEET SIZE: 18 1/2 x 30"
BASE MAP/SOURCE: General Highway Map/Kansas Department of Transportation

The "General Highway Map" is county wide and shows: roads and roadway features, road system designation, railroads, railroad crossings, city and village centers, conservation and recreation sites, boundaries, structures, bridges, farm units, dwellings (in use & not in use), educational and correctional institutions, public service facilities, natural features, industrial sites, navigable streams, drainage, and airways and airports. It is used to locate areas to spray, for directions and to schedule work. This map is also used as a work map by crews to show where they've sprayed and to show chemical sprayed and when. During survey work this map is used to determine work for a time frame as great as a year.

MAP NAME: Riley County Stop Sign Location Map
MAINTAINED BY: Noxious Weed Department
SCALE: 1/2" = 1 mile
NO. SHEETS/SET: one/one
SHEET SIZE: 18 x 21"
BASE MAP/SOURCE: General Highway Map/KDOT

This "Stop Sign Location Map" defines those stop sign areas that require mowing, spraying and the aid of a chain saw to clear signs.

MAP NAME: Riley County Owner Spray Location Map
MAINTAINED BY: Noxious Weed Department
SCALE: 1" = 1 mile
NO. SHEETS/SET: one/one
SHEET SIZE: 3' X 3 1/2'
BASE MAP/SOURCE: Property Ownership Map/Charlson & Wilson

This map illustrates where land owners have sprayed.

MAP NAME: Riley County Musk Thistle Bowhevel Migration Map
MAINTAINED BY: Noxious Weed Department
SCALE: 1" = 1 mile
NO. SHEETS/SET: one (1)
SHEET SIZE: 3' X 3 1/2'
BASE MAP/SOURCE: Property Ownership Map/Charlson & Wilson

This map documents location where the insect was released and documents their migration pattern over the past ten years.

MAP NAME: Riley County Owner Not-Sprayed Map
MAINTAINED BY: Noxious Weed Department
SCALE: 1" = 1 mile
NO. SHEETS/SET: one (1)
SHEET SIZE: 3' X 3 1/2'
BASE MAP/SOURCE: Property Ownership Map/Charlson & Wilson

This "Not-Sprayed Map" locates areas where land owners have not sprayed and should have. After a time,

these owners will be contacted and informed they must spray.

MAP NAME: Musk Thistle Treatment 1987
MAINTAINED BY: Noxious Weed Department
SCALE: 1" = 1 mile
NO. SHEETS/SET: one (1)
SHEET SIZE: 3' X 3 1/2'
BASE MAP/SOURCE: Property Ownership Map/Charlson & Wilson

This "Treatment Map" documents property owners who were sold chemicals and what parcels of land have been sprayed. This map also serves as a tool to determine which areas need to be sprayed.

MAP NAME: Bindweed & Johnson Grass Treatment 1987
MAINTAINED BY: Noxious Weed Department
SCALE: 1" = 1 mile
NO. SHEETS/SET: one (1)
SHEET SIZE: 3' X 3 1/2'
BASE MAP/SOURCE: Property Ownership Map/Charlson & Wilson

This "Treatment Map" documents property owners who were sold chemicals and what parcels of land have been sprayed. This map also serves as a tool to determine which areas need to be sprayed.

MAP NAME: Section & Ownership Map
MAINTAINED BY: Noxious Weed Department
SCALE: 1:400 & 1:200
NO. SHEETS/SET: 516 sheets total/6 sets
SHEET SIZE: 17 x 18"
BASE MAP/SOURCE: Riley County Engineer's Office

Map features section ownership plat. Noxious Weed Department has indicated who owns which parcels and where the owner sprays and for what noxious weed.

MAP NAME: Air Photo
MAINTAINED BY: County Engineer
SCALE: 1:10 scale
NO. SHEETS/SET: Unknown
SHEET SIZE: 18 X 18"
BASE MAP/SOURCE: County Engineer/County Engineer

These air photos are used when large spraying application work is being planned.

MAP NAME: Riley County Rural Phone Directory
MAINTAINED BY: Noxious Weed Department
SCALE: Unknown
NO. SHEETS/SET: Unknown
SHEET SIZE: Unknown
BASE MAP/SOURCE: Unknown/Central Publishing Company

Workers use this "Directory" in the field for various uses. This map is used to mark where a crew has sprayed and for what weed type, scheduling work, and historical purposes. Each truck carries this directory on board. The directory includes a county wide map and includes a maps of

each township with the owner's name. However, it does not have current street names.

SPATIAL DATA FLOW CHARTS:

To understand how these various attributive data bases are used in conjunction with spatial data bases; it is necessary to identify the interdependence and inter-relationship of the documents.

The Non Spray Areas Map is a map indicating which areas are not to be sprayed. When spraying is necessary the map serves to indicate to work crews that special precautions should be taken and that heightened scrutiny of wind conditions and land topography should be given; this is to insure that herbicide sprays will not encroach upon delicate environments.

Though there is no specific data base that the Non Spray Areas Map is tied to; as most of the information contained is placed directly on the map. Non spray areas are determined by property owner notification, road survey crews, and past routine. In a computer GIS environment areas of hazard and caution would be so indicated, by the use of polygons. A polygon display of information is necessitated because vast acres of land would be the area covered. To display the information by point would not give the magnitude in area, that would be covered by a non spray data base. A prerequisite of such a data base would necessitate the formality by which non spray areas are determined and documented. This would require nothing more than indicating on parcel, road, and right-of-way data bases what spatial

areas shouldn't be sprayed with zones of "no spraying" and "high caution spraying" areas.

The Riley County Stop Sign Location Map defines areas requiring spraying to keep signs visible. As an interesting note, the director of the Road and Bridge Department was surprised to discover that stop signs had been mapped. This is a clear example of maps that have been created that other offices and departments could have great utility if they knew they existed. The location of stop signs were determined by NWD survey crews. In a GIS environment the location of all signs would be possible by "overlaying" noxious weed infestation maps with the Road Sign Map (See: Road and Bridge Section). This would be an example of overlaying a polygon based map with a point based map. Though not shown here, an additional map overlay that could be used is the polygon based Non Spray Areas Map.

The Musk Thislle Bowhevel Migration Map is considered to be a user specific map. This migration map documents the migration the Musk Thislle Bowhevel insect. Through sampling of specific (point) weed sites are all that is shown on the present map; it is statistically possible to document the migration pattern in a visual format. The March of this migration may be thought of as contour lines or zones showing outward direction from specific release points. A few of the terrain considerations for overlay would be prevailing winds, topography, soil data, and surface water among others.

The Owner Not-Sprayed Map is a source document used to identify owners who have not sprayed for noxious weeds. In a sense,

this map also documents the progress of chemical spraying in the county. The map begins with a mapping of all property that must be sprayed and as chemicals are sold, from Form 19R; property boundaries are marked "sprayed." Initial areas requiring spraying are determined from survey crews, the Noxious Weed Infestation Complaint Sheet, and past practices. Such a data base then would require the merging of these three mentioned sources with the polygon representation of infested areas.

The Musk Thistle Treatment maps those areas that have been sprayed for Musk Thistle. Since this noxious weed has a wide area of infestation in the county, this map specifically identifies those parcels and right-of-ways which have been sprayed to eradicate Musk Thistle. Form 19R and Form 19RY serve as the data source for mapping property sprayed information. In addition, to the Musk Thistle Treatment map NWD also makes use of a Bindweed and Johnson Grass Treatment map that is prepared in a similar manner. These maps only document parcels that have been sprayed and not the specific acres. In a GIS environment, a map of the specific area requiring spraying would serve to show a property owner the specific area needing spraying.

NWD has made use of the Section Map to identify present owners and operators of land parcels. Many of the concerns that have been mentioned earlier are being reconciled on these maps. Though not as yet completed, Peterson is having owners and operators names placed on these maps and will identify specific areas that require

spraying and for what weeds. This is a cumbersome and slow manual process but NWD clearly understands the utility in having this data presented in a visual format. Once completed the Section and Ownership Map will serve as the official base map for future spraying and weed eradication documentation. Though not an automated GIS, this goal fully embraces the spirit and intent such systems offer.

ATTRIBUTIVE DATA FLOW CHARTS:

Since it has been shown that the Noxious Weed Department has already linked their attributive data with spatial data, there is little value to be obtained from asserting the various benefits such a system can and does achieve. Such a discussion would be only redundant to the above section.

NOXIOUS WEED DEPARTMENT CONCLUSION:

What has been shown; thus, far, as pertains to the Noxious Weed Department, has been existing attributive and spatial data bases; how such data bases are presently used; and how they might be better used in a GIS environment. NWD has demonstrated, in a manual format, how a GIS can creatively aid a department or office in day to day operations. The researcher can find little to add to what has been done by Peterson. His work attest to the potential such systems can enjoin to the work and mission of NWD.

RILEY COUNTY ROAD AND BRIDGE DEPARTMENT

The Riley County Road and Bridge Department is under the responsibility of the County Engineer. However, the director of "Road and Bridge" is Rod Merideth who is in charge of day-to-day operation. Merideth was interviewed to determine present practices at the Road and Bridge Department. The research had two purposes: First, to inventory attributive and spatial data bases maintained or used by the department; and secondly to determine how day-to-day operations might benifit from a GIS.

Road and Bridge is responsible for maintaining all "county" hard surface and gravel roads, county bridges and culverts, county road signs, county road snow removal, and grass and weed mowing in county road right-of-ways. Major construction and repairs (major is defined as that which is operations that are beyond the ability of Road and Bridge to perform), to county roads and bridges are contracted out-of-house. The engineering of such projects are also contracted out-of-house. According to Merideth the county doesn't have the resources or the work load for a full-time staff of engineers, nor does the county have the resources to maintain and own the heavy equipment used in the construction of new bridges and major resurfacing projects.

INVENTORY:

During the inventory of attributive and spatial data bases it was determined that Road and Bridge presently makes use of and maintains six attributive data bases and three spatial data bases.

The attributive data bases are:

Annual Report
Asphalt Roads List
Culvert Survey
Road Sign List
Traffic Counts
Work Order

The spatial data bases are:

Accident Location Map
Master Project Location Map
Rural Phone Directory

It should be noted that some of the attributive data bases are titled reports and surveys. Merideth informed the researcher that these various reports serve as the original source for much of the information they contain. The documents, in a sense, are field sheets as they relate to the condition and status of roads, bridges, culverts, and signs. Specifically, these data bases are listed as the following:

Riley County Road & Bridge Department
Attributive Data Bases

Rod Merideth
2711 Anderson Ave., Manhattan: 539-2981

D/B NAME: Riley County Road Sign List
MAINTAINED BY: Road & Bridge Department
SOURCE: Road & Bridge Department
SIZE: Unknown
TYPE OF INFO: inventories all road signs
TYPICAL USE: for sign replacement

The Road and Bridge Department conducts a bi-weekly sign survey to inspect the condition of all road signs. The survey is a visual inspection in nature and is conducted on a route by route basis. In addition, another sign survey is conducted with odometer accuracy bi-annually to check for accurate spacing of signs.

D/B NAME: Work Order
MAINTAINED BY: Road & Bridge Department
SOURCE: Road & Bridge Department
SIZE: varies
TYPE OF INFO: (see below)
TYPICAL USE: (see below)

The "Work Order" is retained on permanent record; it shows the cost of labor and materials for a project. The work order serves as original data for the annual report prepared by the Road & Bridge Department. The work order documents type of work and frequency of resurfacing and is used to determine work priorities for the next years budget. Specifically the work order documents: who to charge work to, who work is issued to, the location of work, description of work, construction or maintenance work, and whether the work was asphalt resurfacing. For bridge repairs the work

order documents: concrete repairs, bridges that are panted, and miscellaneous bridge work. For ground grading the work order describes, whether it was channel work or some other type of work.

D/B NAME: Riley County Asphalt Roads List
MAINTAINED BY: Road & Bridge Department
SOURCE: Road & Bridge Department
SIZE: unknown
TYPE OF INFO: (see below)
TYPICAL USE: documentation of asphalt roads

This list identifies all asphalt roads Riley County is responsible for and common street name, street number, a roads length in miles and a streets official name.

D/B NAME: Annual Report
MAINTAINED BY: Road & Bridge Department
SOURCE: Road & Bridge Department
SIZE: varies
TYPE OF INFO: (see below)
TYPICAL USE: (see below)

The "Annual Report" is a working document for the Road and Bridge Department. This report documents right of way widths, utility cuts, road surface type, location of utility lines, number of driveways on a parcel of land, location of road signs, and location of hard and gravel roads.

D/B NAME: Culvert Survey
MAINTAINED BY: Road & Bridge Department
SOURCE: Road & Bridge Department
SIZE: unknown
TYPE OF INFO: (see below)
TYPICAL USE: (see below

The "Culvert Survey" is prepared annually and is used to determine condition of culverts in the county. This survey documents: name, size, and width of roadway, type of culvert, critical deficiencies and lists any comments by the surveyor.

D/B NAME: Traffic Count
MAINTAINED BY: Road & Bridge Department
SOURCE: Road & Bridge Department
SIZE: unknown
TYPE OF INFO: (see below)
TYPICAL USE: (see below)

The "Traffic Count" documents presents traffic count data and gives road name, surface type, date survey was completed, the count for summer and winter, and location of the counter.

Riley County Road & Bridge Department
Spatial Data Bases

Rod Merideth
2711 Anderson Ave., Manhattan: 539-2981

MAP NAME: Master Project Location Map
MAINTAINED BY: Road & Bridge Department
SCALE: 1" = 3 mile
NO. SHEETS/SET: one (1)
SHEET SIZE: 10 x 11"
BASE MAP/SOURCE: General Highway Map/Kansas Department of Transportation

The "Master Project Location Map" is a county wide map showing: roads and roadway features, and road system designations. This map serves as a master listing for work in progress and how far along such work is. Each crew supervisor, at the end of a workday, marks his crews progress from field notes on the Master Project Location Map.

MAP NAME: Accident Location Map
MAINTAINED BY: Road & Bridge Department/RCPD
SCALE: 1/2" = 1 mile
NO. SHEETS/SET: one (1)
SHEET SIZE: 18 1/2 x 30"
BASE MAP/SOURCE: General Highway Map/KDOT

The "Accident Location Map" indicates three type of accidents: animal hit, injury accident and non-injury accident. This map doesn't document a specific time frame, rather it is a continues record of accidents on Riley County roads.

MAP NAME: Riley County Rural Phone Directory
MAINTAINED BY: Road & Bridge Department
SCALE: Unknown
NO. SHEETS/SET: Unknown
SHEET SIZE: Unknown
BASE MAP/SOURCE: Unknown/Central Publishing Company

Workers use this Directory in the field for various uses. This map is used to mark where a crew has worked, for scheduling work, and historical purposes. Each truck has this directory on board. The directory includes a county wide map and has a maps of each township with parcel owner names.

SPATIAL DATA FLOW CHARTS:

To understand how these various attributive data bases are used in conjunction with spatial data bases; it is necessary to identify the interdependence and inter-relationship of the documents.

The Accident Location Map is based on two attributive data bases, one maintained within Road and Bridge and the other obtained from the Riley County Police Department (RCPD). Information on all injury and non-injury accidents on county roads are obtained from RCPD. Information on animal hits, commonly called "road kills," is obtained from RCPD Accident Reports, complaints (translated to Work Order), and by work crews. The location of accidents on the Accident Location Map is "point" data. A specific incident had taken place at a specific point.

The Accident Location Map is more than a static document of events. Though it is admittedly not a scientific study, the result is accident patterns are clearly defined to aid Road and Bridge for the placement of deer crossing signs and the placement of stop or yield signs. Intersections that are hazardous to motorists are easily "pin pointed" to determine the need for redesign and prioritizing for major construction efforts. In a GIS environment, this information would be easily obtained from down loading RCPD Accident Report files and Road and Bridge Work Order files. Road and Bridge is using a low-technology solution to very beneficial results. The present "pin map" solution, with little cost for a base map and some color pins, has brought results that help save the lives and property of citizens.

A second relationship of spatial data in conjunction with attributive data is the Master Project Location Map and the Riley County Rural Phone Directory cross referenced with the Work Order file.

All work begins with the Work Order. The Work Order specifies the job to be done and its location. The crew supervisor that a specific Work Order is assigned takes care not to damage this document and immediately, upon assignment, transfers the data to his copy of the Riley County Rural Phone Directory. In the field, as work is completed the supervisor marks progress in Directory. At the end of a workday, progress is transferred from the Directory to the Master Project Location Map. This procedure allows the Road and Bridge

director to easily supervise progress and easily determine trouble areas for the next year.

It is apparent that the combined use of spatial and attributive data is rather limited at the Road and Bridge Department. Work that is performed and information that is needed by Road and Bridge relies heavily upon experience, memory and routine. This research does not seek to determine the effectiveness and efficiency Road and Bridge performs its job. Rather, it is the researchers task to inventory existing data bases and determine how they might better be applied in a GIS environment.

ATTRIBUTIVE DATA FLOW CHARTS:

In review of the various attributive data bases, as they pertain to the Road and Bridge Department, it is necessary to determine and establish their link to a spatial format. This is the real crux of this project to determine what relationship attributive data has to "points," "lines," and "polygons" and then to better document that flow.

The Riley County Road Sign List is made up of various "points." Each sign represents a specific placement of a sign, whether that be a stop, street, deer crossing, or speed limit sign. The Riley County Road Sign List can easily be placed in a GIS environment. Each point referenced in the spatial file would be linked by a geo-code to a corresponding attributive file.

The Riley County Asphalt Roads List is made up of various "lines." Each asphalt road, as it relates to the county, is a liner feature

with a beginning and an end, be that nothing more then running from border to border. Such liner features would need to be linked with an attributive data file that would indicate the name of the road, its length, type and base thickness. Road and Bridge uses economic indicators, cost in dollars, to determine the extent of work performed on a road. This allows easily comparative data for determining priorities for each fiscal year. A GIS is well suited for such comparisons. The money spent for drainage control, in surface material, snow & ice control, weed & brush control, traffic control (signs), and "other maintenance" can be easily linked to a liner feature, such as a road. To determine more specific areas of costs, that is to "pin point" specific, costly spots a system of "nodes" would need to be placed, thus making the liner feature a series of lines connected by points. This would allow a specific determination of cost, instead of the existing system of applying these figures to the entire road.

The Culvert Survey is point data that features specific culverts under bridges. In the spatial file each point would be represented and the attributive data needed would include street name, size of culvert (length, height, and square footage), width of roadway at approach and structure, type of culvert (concrete, reinforced concrete, steel, wood, or stone), type of bridge surface (asphalt, gravel, or dirt). The attributive data file should also indicate critical deficiencies, such as structural, drainage, roadway width, handrail, existing signing, guard rail, surface paint, and weeds.

The Riley County Traffic Count is attributive data that seeks to document the use of county roads. The Riley County Traffic Count; in fact, documents the number of times vehicles pass over a specific point. As such the spatial file would need to classify the traffic count as a point and link these points to an attributive data file that documents road name, surface type, date survey was completed, summer and winter counts.

ROAD AND BRIDGE CONCLUSION:

What has been shown; thus far, as pertains to the Road and Bridge Department, has been existing attributive and spatial data bases; how such data bases are presently used; and how they might be better used in a GIS environment. What is left to be determined is what additional data files would be of benefit to the Road and Bridge Department that are not presently consulted. The author can only speculate how data files showing precipitation, snow fall and drifts, drainage patterns, hazardous waste and dangerous material routes, and flood levels would effect the process in determining culvert and bridge work priorities. These are just a few of the possible avenues of study that need further research to determine the full potential of GIS.

RILEY COUNTY POLICE DEPARTMENT

The Riley County Police Department (RCPD) is a unique department as it provides police protection for both the entire county and within Manhattan City. Because of RCPD comprehensive police coverage it is a unique county office; as such, unlike most other county offices, RCPD performs a significant portion of its work in the city limits of Manhattan. The director of RCPD is Alvin Johnson. However, Captain Robert Wild is in charge of day-to-day information and report maintenance. Captain Wild was interviewed to determine present practices at the RCPD. The research had two purposes: First, to inventory attributive and spatial data bases maintained or used by the department; and secondly to determine how day-to-day operations might benefit from a GIS.

INVENTORY:

During the inventory of attributive and spatial data bases it was determined that RCPD presently makes use of and maintains six attributive data bases and seven spatial data bases.

The attributive data bases are:

Complaint Card File
Offense Report File
Notice to Appear File
Motor Vehicle Accident Report
Field Investigation Card
911 Emergency Response

The spatial data bases are:

Manhattan Traffic Accident Pin Map
Riley County Traffic Accident Pin Map
Criminal Incident Map
Manhattan City Street Map (Wall)
Riley County Street Map (Wall)
Manhattan City Street Map (Pocket)
Riley County Rural Phone Directory

Specifically, these data bases are listed as the following:

Riley County Police Department
Attributive Data Bases
Cpt. Robert Wild
600 Colorado, Manhattan: 537-2112

D/B NAME: Complaint Card
MAINTAINED BY: RCPD
SOURCE: RCPD
SIZE: approx. 35 000 per year
TYPE OF INFO: (see below)
TYPICAL USE: (see below)
(Manual)

The "Complaint Card" initiates all investigations reported to RCPD. All cards are micro filmed monthly. These cards are used to record three types of events: personal, property, or non-criminal. The Card documents the following information: complainants name, nature of

complaint, serial number, complainant's address, phone number, location of offense or incident, person reported by, address, phone number, person received by, time, date, officers assigned, and how reported. There is also space for written details of complaint or incident.

D/B NAME: Offense Report
MAINTAINED BY: RCPD
SOURCE: RCPD
SIZE: approx. 9 000 per year
TYPE OF INFO: (see below)
TYPICAL USE: (see below)
(Manual)

The "Offense Report" is used for investigative purposes and historical documentation. The offense report is used in the second stage of investigation. This document is used only when there is evidence of a crime. The offense report is a three page document. All offense reports are micro-filmed yearly. The report has ample space to document crimes against persons and property (see appendix). Briefly the offense report includes name of persons, property events, person events, modus operandi (MO) for event and offense, all the where, what, and when, and how details for the event and the offender's physical appearance, and many other details regarding an event.

D/B NAME: Notice to Appear
MAINTAINED BY: RCPD
SOURCE: RCPD
SIZE: approx. approx. 13 000 per year
TYPE OF INFO: (see below)
TYPICAL USE: (see below)
(Manual)

The "Notice to Appear" is more commonly known as a traffic ticket. A copy of the notice is sent to the County Court. After 90 days, RCPD destroys their copy of this notice.

D/B NAME: Motor Vehicle Accident Report
MAINTAINED BY: RCPD
SOURCE: RCPD
SIZE: approx. 5 000 per year
TYPE OF INFO: (see below)
TYPICAL USE: (see below)
(Manual)

Manhattan city uses the "Motor Vehicle Accident Report" to determine speed change, and stop light placement. The accident report is a four page document (see appendix). Primarily the information documented is accident location, name of persons involved, type of vehicles, cause of accident, and severity of accident.

D/B NAME: Field Investigation Card (Interrogation Card)
MAINTAINED BY: RCPD
SOURCE: RCPD
SIZE: approx. 1 400 per year
TYPE OF INFO: (see below)
TYPICAL USE: (see below)
(Manual)

The "Field Investigation Card" is a 3 x 5 card that is used to document any unknown activities of persons an officer might meet during the performance of his or her duty. Information documented on this card are: name, personal identification, purpose of interrogated persons activities, and any other comments the officer might wish to make.

D/B NAME: 911
MAINTAINED BY: Southwestern Bell
SOURCE: Southwestern Bell
SIZE: All phones numbers in the Southwestern Bell network.
TYPE OF INFO: (see below)
TYPICAL USE: (see below)

The "911" data base offers the following: Name, number, address, emergency response number area and a three line decode number for emergency purposes. This data base may only be accessed by a person calling the 911 number. It is used to expedite emergency service only and not for criminal investigation. RCPD can't access this data base an incoming phone call is the mechanism to activate the system. All calls are taped and recycled ever 45 days.

Riley County Police Department
Spatial Data Bases

Cpt. Robert Wild
600 Colorado, Manhattan: 537-2112

MAP NAME: Manhattan Traffic Accident Pin Map
MAINTAINED BY: RCPD
SCALE: Unknown
NO. SHEETS/SET: one/one
SHEET SIZE: 6 x 10 feet
BASE MAP/SOURCE: Official City Map/City of Manhattan

The "Manhattan Traffic Accident Pin Map" shows the location of all traffic accidents in the city for the past year. Four color pins are used to indicate: fatal accidents, injury accidents, non-injury accidents, and pedestrian accidents.

MAP NAME: Riley County Traffic Accident Pin Map
MAINTAINED BY: RCPD
SCALE: 1" = 1/2 mile
NO.SHEETS/SET: two sheets per set
SHEET SIZE: 34 x 36"
BASE MAP/SOURCE: Map of Riley County/Planning & Zoning

The "Riley County Traffic Accident Pin Map" shows the location of all traffic accidents in the county for the past year. Four color pins are used to indicate: fatal accidents, injury accidents, non-injury accidents, and pedestrian accidents.

MAP NAME: Criminal Incident Map
MAINTAINED BY: RCPD
SCALE: Unknown
NO. SHEETS/SET: one/one
SHEET SIZE: 6 x 10 feet
BASE MAP/SOURCE: Official City Map/City of Manhattan

The "Criminal Incident Map" is used to mark the location of events with the same MO. It is used sporadically on an officers own initiative to investigate a series of events.

MAP NAME: Manhattan City Street Map
MAINTAINED BY: City of Manhattan
SCALE: Unknown
NO. SHEETS/SET: one/one
SHEET SIZE: 6 x 10 feet
BASE MAP/SOURCE: Official City Map/City of Manhattan

This is a street location Map used by RCPD dispatchers to assist officers in the field.

MAP NAME: Riley County Street Map (Map of Riley County)
MAINTAINED BY: Planning & Zoning
SCALE: 1" = 1/2 mile
NO.SHEETS/SET: two sheets per set
SHEET SIZE: 34 x 36"
BASE MAP/SOURCE: Map of Riley County/Planning & Zoning

The "Riley County Street Map is used to show road names. Is used for 911 street name requirements and to assist officers in the field. There are over 337 street names in unincorporated areas of Riley County.

MAP NAME: Manhattan City Street Map
MAINTAINED BY: Manhattan Chamber of Commerce
SCALE: 3.5 centimeters = 1 mile (metric scale)
NO. SHEETS/SET: 1/1
SHEET SIZE: 16 X 22"
BASE MAP/SOURCE: Manhattan City Street Map/Manhattan Chamber of Commerce

The "Manhattan City Street Map" is used by officers in the field for various uses.

MAP NAME: Riley County Rural Phone Directory
MAINTAINED BY: Central Publishing Company
SCALE: Unknown
NO. SHEETS/SET: Unknown
SHEET SIZE: Unknown
BASE MAP/SOURCE: Unknown/Central Publishing Company

Officers use the "Riley County Rural Phone Directory" in the field for various uses. The directory includes a county wide map and maps of each township with individual parcel owner's name. However, this directory it does not have current street names.

SPATIAL DATA FLOW CHARTS:

To understand how these various attributive data bases are used in conjunction with spatial data bases; it is necessary to identify the interdependence and inter-relationship of the documents.

This research does not seek to determine the effectiveness and efficiency Riley County Police Department performs its job. Rather, it

is the researchers task to inventory existing data bases and determine how they might better be applied in a GIS environment.

The Manhattan Traffic Accident Pin Map is a compilation of all vehicular accidents, for the past year, within the city limits of Manhattan. Because this mapping is within Manhattan, there would most surely be a need to link such a data base with a city GIS. This study shall not deluge into such a scheme, however it is necessary to be cognoscente of such a possibility. Presently this pin map indicates: fatal accidents, injury accidents, non-injury accidents and pedestrian accidents. An important type of auto accident that is not presently recorded on the pin map are hit-and-runs. There would be little difficulty in adding hit-and-runs in a GIS environment. This spatial data base is linked to the Motor Vehicle Accident Report. As a pin map, the display of information is in a "point" format. This format is easily presentable in a GIS environment and would be subject to the various statistical analysis.

The Riley County Traffic Accident Pin Map is essential the same as the Manhattan Traffic Accident Pin Map, except it covers the streets and roads of Riley County instead of Manhattan. It should be noted that what is not documented on this map but is by the Road and Bridge Department are accidents involving animals. Though this is not viewed as a major benefit of a GIS, it serves as an example of the value of integrating data files for the use of many users.

The Criminal Incident Map is sporadically used by RCPD. In a GIS environment, such information would be of invaluable utility. A

useful breakdown of offenses are: armed robbery, assault, burglary, auto theft, rape, and DUI. The Offense Report is the best attributive data base source, as it only documents an offense "if there is evidence of a crime." With some 9 000 Offense Reports filed each year such a data base would provide a large enough population to analysis offenses in relationship to geographic areas. This pin map is documenting "point" data as each offense occurs in one specific place.

The other present use RCPD has for spatial data are for dispatch purposes and officers in the field. These maps are nothing more than grid based street maps indicating street locations. This system is similar to a highway road map. A more comprehensive system that takes into account apartment and mobile home park complex is discussed in the Riley County Emergency Medical Service section of this document. Though not presently used by RCPD, there is a real benefit for emergency response if these two departments could share this spatial data base.

ATTRIBUTIVE DATA FLOW CHARTS:

In review of the various attributive data bases, as they pertain to the Riley County Police Department, it is necessary to determine and establish their link to a spatial format. This is the real crux of this project to determine what relationship attributive data has to "points," "lines," and "areas." The Motor Vehicle Accident Report and the Offense Report have been discussed above. The 911 data base is

reviewed in the Emergency Medical Service section of this document. The remaining three attributive files are of a transient nature when compared to the previous three. The Complaint Card File is an important source document for RCPD but over half of the calls contained under this file are of a non-criminal nature. This ranges from "non-complaint" such as requesting a vehicle for a funeral procession to crank calls. The Notice to Appear is just that a statement informing a person that they are to appear in court. RCPD retains these for only 90 days. The third data base is the Field Investigation Card. From discussions with Captain. Wild it is the researcher's understanding the information contained on these cards are of value only for documenting very recent offenses, less than a week. Since only the point where a person is encountered is documented and no specific offense is stated, one is hard pressed to make more out of the information contain on the Field Investigation Card.

RILEY COUNTY POLICE DEPARTMENT CONCLUSION:

What has been shown; thus far, as pertains to the Riley County Police Department, has been existing attributive and spatial data bases; how such data bases are presently used; and how they might be better used in a GIS environment. This is the end of the scope of this research. What is left to be determined is what additional data files would be of benefit to the RCPD that are not presently consulted or collected. There are other possible avenues of study that need further

research to determine the full potential of GIS. Two examples are burglary trend analysis (to determine what areas have a high probability to experience burglary) or rape prevention studies (to determine any patterns in settings or areas). The use of GIS in criminology has great potential for further study.

RILEY COUNTY PLANNING AND ZONING DEPARTMENT

The Riley County Planning and Zoning Department is responsible for developing and updating the county comprehensive plan, enforcement of zoning regulations, and enforcement of subdivision regulations. Monty Wedel, Riley County Planner, was consulted for the inventory of attributive and spatial data bases maintained or used by the Planning and Zoning Department. The overriding responsibility of this department is in administrating zoning regulations, subdivision regulations, and, as staff for the Riley County Planning Commission and Board of Zoning Appeals, to assist in the review and development of subdivision plats and development. The research had two purposes: First, to inventory attributive and spatial data bases maintained or used by the department; and secondly to determine how day-to-day operations might benefit from a GIS.

INVENTORY:

During the inventory of attributive and spatial data bases it was determined that the Riley County Planning and Zoning Department presently makes use of and maintains five attributive data bases and fourteen spatial data bases.

The attributive data bases are:

Subdivision Plats Filed
Riley County Street Name Locater List
Building Permit Record
Real Property Appraisal Card
Tax Roll

The spatial data bases are:

Official Zoning Maps
Subdivision Final Plats
Important Farmlands Map
General Highway Map
Existing Land Use Map
Rural Water Districts Map
Soil Survey Riley County
Riley County Street Map
Riley County Fire District Map
Future Land Use Map
Flood Plain Maps
USGS 7.5-Minute Maps
Construction Materials Inventory
Physical & Environmental Characteristics Map

Specifically, these data bases are listed as the following:

PLANNING AND ZONING
Attributive Data Bases
Monty Wedel
110 Courthouse Plaza, Manhattan: 537-6332

D/B NAME: Subdivision Plats (Approved & Denied)
MAINTAINED BY: Planning and Zoning
SOURCE: Planning and Zoning
SIZE: history of all plats submitted to the County
TYPE OF INFO: (see below)
TYPICAL USE: historical document
(Manual)

The "Subdivision Plats (Approved & Denied)" data base includes: Petition number, petitioner, tract number, acres, number of lots, dates of meetings and decisions, subdivision involved. This data base serves as a historical record and as an index of possible development for the future.

D/B NAME: Riley County Street Name Locater List
MAINTAINED BY: Planning and Zoning
SOURCE: Planning and Zoning
SIZE: lists all street names in Riley County
TYPE OF INFO: Street Names and Location
TYPICAL USE: naming streets for 911 system
(Manual)

The "Street Name Locater" lists all roads in Riley County. As required by the 911 response system, all roads must have street names.

D/B NAME: Building Permit Record
MAINTAINED BY: Planning and Zoning
SOURCE: Planning and Zoning
SIZE: +-80 per year (back to early '50s)
TYPE OF INFO: (see below)
TYPICAL USE: zoning permits/property appraisal
(Manual)

The "Building Permit" records: owners name, legal description of property, how such property is zoned, use, occupancy, type of building, number of rooms, number of stories high, estimated cost of construction; whether there is electrical work, type of sewage disposal system or plumbing work, and health permit number. A building permit serves as a record for planning and zoning for locating where development is happening and serves as an initial document for tax appraisal.

D/B NAME: Tax Roll
MAINTAINED BY: County Clerk
SOURCE: County Clerk
SIZE: approx. 20 000 parcels
TYPE OF INFO: (see below)
TYPICAL USE: for location of property owners
(Manual & Automated)

The "tax roll" includes the following data: name and address of taxpayer, legal description of taxable land, tract number, tax unit, value, mill levy, general tax, applicable specials, total tax, half tax, and delinquent tax.

D/B NAME: Real Property Appraisal Card
MAINTAINED BY: County Appraiser
SOURCE: County Appraiser
SIZE: approx. 20 000 cards
TYPE OF INFO: (see below)
TYPICAL USE: To determine assessed property tax

Each appraisal card is anchored to an individual land parcel. Information on the owner is given and so is a legal description, building permit record, neighborhood data, description of the site, estimated land value, estimated value by market data approach, estimated value of other buildings or additions, type of building construction, estimated value by cost approach, and estimated value by income approach. There is space available for a sketch of the property boundary and placement of structure footprints.

PLANNING AND ZONING
Spatial Data

Monty Wedel
110 Courthouse Plaza, Manhattan: 537-6332

MAP NAME: Official Zoning Maps
MAINTAINED BY: Planning & Zoning
SCALE: 1:400 & 1:200
NO. SHEETS/SET: 516 sheets total/6 sets
SHEET SIZE: 17 x 18"
BASE MAP/SOURCE: County Section Map/Riley County Engineer

The "Official Zoning Map" features section ownership plat and lists the following zoned districts: residential, multi-family, commercial, industrial, flood plain, university development, agriculture, airport noise hazard district, PUD-residential, PUD-commercial, PUD-industrial, conditional use, variance, and Manhattan City limits.

MAP NAME: Subdivision Final Plats
MAINTAINED BY: Planning & Zoning
SCALE: 1:100 & 1:50
NO. SHEETS/SET: 110 Plats
SHEET SIZE: 18 x 24"
BASE MAP/SOURCE: varies/varies

A typical final plats contain both spatial and attributive data. The "Final Plat" serves as a record for planning and zoning for locating where development is happening and to what extent such land is developed.

MAP NAME: Important Farmlands Map
MAINTAINED BY: KU Geological Survey in Coop w/ Soil Conservation Service
SCALE: 1:24 000
NO. SHEETS/SET: one (1)
SHEET SIZE: 28 x 22"
BASE MAP/SOURCE: KU Geological Survey in Coop w/ Soil Conservation Service

The "Important Farmlands Map" is a county wide map showing all prime farmland, farmland of statewide importance, other land, water areas, and approximate limits of urban growth.

MAP NAME: General Highway Map
MAINTAINED BY: Kansas Department of Transportation
SCALE: 1/2" = 1 mile
NO. SHEETS/SET: one (1)
SHEET SIZE: 18 1/2 x 30"
BASE MAP/SOURCE: General Highway Map/Kansas Department of Transportation

The "General Highway Map" is a county wide map showing: roads and roadway features, road system designation, railroads, railroad crossings, city and village centers, conservation and recreation sites, boundaries, structures, bridges, farm units, dwellings (in use & not in use), educational and correctional institutions, public service facilities, natural features, industrial sites, navigable streams, drainage, and airways and airports.

MAP NAME: Existing Land Use Map
MAINTAINED BY: Planning & Zoning
SCALE: 1" = 1 mile
NO. SHEETS/SET: one (1)
SHEET SIZE: 36 x 50"
BASE MAP/SOURCE: General Highway Map/KDOT

The "Existing Land Use Map" features agriculture and undeveloped land uses in the county. Residential sites Single Family and Farmsteads are shown on the map, plus conventional construction, mobile homes, commercial, industrial, public and semi-public, parks and recreation sites.

MAP NAME: Rural Water Districts Map
MAINTAINED BY: Planning and Zoning
SCALE: varies
NO. SHEETS/SET: varies
SHEET SIZE: varies
BASE MAP/SOURCE: varies

The "Rural Water Districts Map" shows rural water district boundaries. Rural water districts appear not to be of great importance to the county as these maps serve more as historical records than as a working document.

MAP NAME: Soil Survey Riley County
MAINTAINED BY: USDA, Soil Conservation Service
SCALE: 1:24 000
NO. SHEETS/SET: 40 sheets per set
SHEET SIZE: 11 x 17"
BASE MAP/SOURCE: line overlay on air photo/USDA Soil Conservation Service

The "Soil Survey" contains both attributive data and spatial data. It is presented in the spatial section since the spatial location of various soil types is its main function. The soil survey of Riley County "contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, or other structures; and in appraising the suitability of tracts of land for farming, industry, or recreation."

MAP NAME: Riley County Street Map (Map of Riley County)
MAINTAINED BY: Planning & Zoning
SCALE: 1" = 1/2 mile
NO. SHEETS/SET: 2 sheets per set
SHEET SIZE: 34 x 36"
BASE MAP/SOURCE: Map of Riley County/Planning & Zoning

The "County Street Map" is a wall map used to document road name changes. It's used for 911 street name requirements.

MAP NAME: Riley County Fire District Map
MAINTAINED BY: Planning & Zoning
SCALE: 1/2" = 1 mile
NO. SHEETS/SET: one/one
SHEET SIZE: 18 x 21"
BASE MAP/SOURCE: General Highway Map/KS Department of Transportation

The "Riley County Fire District Map" shows approximate boundaries of rural response ranges and location of fire houses.

MAP NAME: Future Land Use Map (Proposed)
MAINTAINED BY: Planning & Zoning
SCALE: 1" = 1 mile
NO. SHEETS/SET: one/one
SHEET SIZE: 36 x 50"
BASE MAP/SOURCE: General Highway Map/KS Department of Transportation

The "Future Land Use Map" is a county wide map showing future and existing land uses by: residential,

commercial, public & semi public, parks and recreation, arterial streets, collector streets, future collectors, and planning area boundary.

MAP NAME: FEMA Flood Plain Maps
MAINTAINED BY: Federal Emergency Management Agency (FEMA)
SCALE: varies
NO. SHEETS/SET: 16 sheets/one set
SHEET SIZE: varies
BASE MAP/SOURCE: FEMA/FEMA

The County Engineer holds only those FEMA flood plain maps that are for unincorporated areas.

MAP NAME: USGS 7.5-Minute Maps
MAINTAINED BY: US Geological Survey (USGS)
SCALE: 1:24 000
NO. SHEETS/SET: 20 sheets per set for County
SHEET SIZE: 22 X 28"
BASE MAP/SOURCE: USGS/USGS

The county appraiser uses 7.5-minute map to locate section lines and to determine various errors during surveys. The USGS 7.5 minute map features contour lines, streams, natural lakes and ponds, manmade lakes and reservoirs, canals, aqueducts, and ditches, roads and railroads, bridges, buildings and urban areas, pipelines, power transmission lines, airway facilities, oil and gas fields, industrial plant areas, cemeteries and graves, recreational areas, historical landmarks, open-pit mines and quarries, and vegetation.

MAP NAME: Construction Materials Inventory of Riley County No. 35.
MAINTAINED BY: Kansas Department of Transportation (KDOT)
SCALE: 1" = 1 mile
NO. SHEETS/SET: 12 per set/one set
SHEET SIZE: 11 X 17"
BASE MAP/SOURCE: KDOT/KDOT

This "Inventory" is in a 95 page booklet distributed by KDOT. It offers a general assessment of geological conditions in Riley County. This inventory is written in text and includes illustrations and maps.

MAP NAME: Physical & Environmental Characteristics Map
MAINTAINED BY: Planning & Zoning
SCALE: 1" = 1 mile
NO. SHEETS/SET: one/one
SHEET SIZE: 36 x 50"
BASE MAP/SOURCE: General Highway Map/KS Department of Transportation

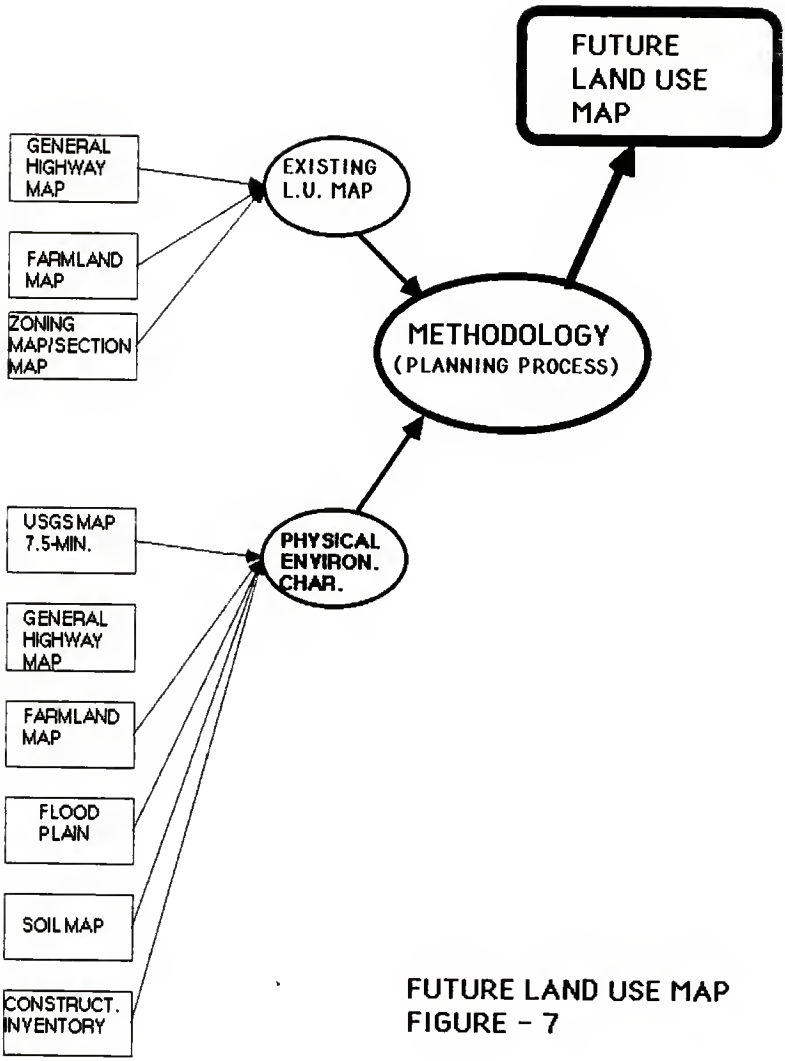
The "Physical & Environmental Characteristics Map" lists major map features and present: prime farmland, farmland of statewide importance, floodway, flood hazard areas, soils suitable for septic systems, shallow bedrock, rock quarries, and gravel pits.

SPATIAL DATA FLOW CHARTS:

To understand how these various attributive data bases are used with spatial data bases; it is necessary to identify the interdependence and inter-relationship of the documents.

This research does not seek to determine the effectiveness and efficiency Riley County Planning and Zoning Department performs its job. Rather, it is the researchers task to inventory existing data bases and determine how they might better be applied in a GIS environment.

The topology of the "proposed" Future Land Use Map is a compilation of nine (9) spatial data bases. The Existing Land Use Map and the Physical and Environmental Characteristics Map are the basic data sources for the analysis of applied planning methodology in determining Riley County's future land use. The Existing Land Use Map is a composite of the three (3) following spatial data bases: Official Zoning Map; Important Farmlands Map; and the General Highway Map. The Physical and Environmental Characteristics Map is a composite of the six (6) following spatial data bases: FEMA Flood Plain Maps; Construction Materials Inventory; USGS 7.5-Minute Maps; Riley County Soil Survey; Important Farmlands Map; and the General Highway Map. The following flow chart illustrates the distribution of data and process in developing the Future Land Use Map:



FUTURE LAND USE MAP
FIGURE - 7

Three maps, though important spatial data bases, stand alone and have not been significantly integrated with other data bases. These three maps are the Rural Water Districts Map, Riley County Street Map, and the Riley County Fire District Map. These three maps though have important boundary and street name data that would be important spatial and attributive data files. These are static data bases for the most part and are subject to a variety of uses.

The Subdivision Final Plats is tied to the subdivision regulator process. The specifics of this process is not critical here, what is is the requirement that the drafting and design be performed by the developer or subdivider. In review of sketch or preliminary plats, what one might assume would be of assistance is the application of site selection modeling. For example, performing a housing site selection model would be of value in determining suitablity, but in theory such models should have been applied in determining the zoning and future land use. In other words, at this point in the planning process, with a sketch or preliminary plat for review by the Planning Commission, the Planning and Zoning Department is limited to recommendations that apply to the zoning and subdivision regulations. This is far past the time to be reviewing site suitability for housing in a residental zone or whether the subdivision regulations adequately address any given issue.

ATTRIBUTIVE DATA FLOW CHARTS:

In review of the various attributive data bases, as they pertain to the Riley County Planning and Zoning, it is necessary to determine and establish their link to a spatial format. This is the real crux of this project to determine what relationship attributive data has to "point," "line," and "area or polygon."

The Building Permit Record is of value not only to Planning and Zoning but are also important to the County Appraiser. Tying this attributive data to the spatial data, whether it be a Subdivision Final Plat or to an existing parcel serves as a ready base for determining the value of property and the assessment of property taxes. As a pin map, that is using this data in a point format, trends in determining "hot" development areas in the county may be determined.

As discussed in other Sections of this Chapter the Tax Roll which names parcel property owners, is of value in contacting property owners for any zoning changes. However, it is usually the developers responsibility to provide a list of property owners names for such cases and therefore, as it relates to Planning and Zoning, this benefit is actually of limited value.

RILEY COUNTY PLANNING AND ZONING CONCLUSION:

What has been shown; thus far, as pertains to the Riley County Planning and Zoning Department, has been existing attributive and spatial data bases; how such data bases are presently used; and how

they might be better used in a GIS environment. What is left to be determined is what additional data files would be of benefit to Planning and Zoning that are not presently consulted or collected. There are other possible avenues of study that need further research to determine the full potential of GIS. Two examples are development trend analysis (to determine what areas have a greater probability to experience development) or site selection studies (to determine highest use for zoning). The use of GIS in planning has great potential for further study.

KANSAS REAPPRAISAL

Riley County has contracted with Conley, Kight, and Eckford: Appraisal and Mapping Services for reappraisal purposes required by State mandate. The amount and level of information that is being collected on land parcels is outstanding; data collectors inspect the property, measure all improvements, and record construction type information. They also ask questions about the interior components. An experienced appraiser then inspects the property and makes judgements regarding the quality of construction and the amount of depreciation. For commercial/industrial properties, information about income and expenses is also collected (Donatello 1987).

Though the mapping process has been contracted out to Conley, Kight, and Eckford, a significant level of data must be obtained directly from the County's offices and departments. The following data that is necessary for reappraisal and is linked to each parcel of land that is presently plated. The key in appreciating the level of information that is being generated is that a full half or more of the cost in a GIS is attributed to data collection, not formatting or data input, but simply collecting the data (Devine 1986).

The Rectified Vertical Aerial Photography needed for reappraisal is supplied by the County that includes, from Phase 1 - Section 1.2 of the Riley County Contract Agreement and Technical Specifications for Property Ownership Mapping Services and Ownership Maps:

"1.2.1 A high altitude flight for obtaining 1" = 2000" negative scale aerial photography to be used in producing a complete set of rectified aerial photo positive screened enlargements at the scale of 1" = 400' containing (4) sections of land (2) miles square * * * .

"1.2.2 A low altitude flight for obtaining 1" = 500' negative scale aerial photography of the highly urbanized area of cities, towns and villages requiring the scale of 1" = 100' rectified photo positive screened enlargements for property tax mapping. Each 1" = 100' photo enlargement shall represent (1/4) of a section of land (1/2) mile square, resulting in (4) reproductions to a section where applicable.

"1.2.3 One (1) photo index and one (1) complete stereo set of contact prints of the 1" = 2000' negative scale aerial photography covering the entire county. * * *

"1.2.4 One (1) photo index and one (1) complete set of contact prints of 1" = 1000' negative scale aerial photography and 1" = 500' negative scale aerial photography of the towns, cities, villages and any other urbanized areas * * *."

From the County's recorded records a wealth of information can and will be obtained, linking parcel property attributive data to parcel spatial maps. As listed in the Contract with Conley, Kight, and Eckford: Appraisal and Mapping Services under "Phase 2 - County's Recorded Records" the following list of already obtainable data is outlined:

"2.1 The Register of Deeds' Office grantor and grantee indexes, deed books and/or microfiche or aperture cards for making deed copies.

"2.2 The Register of Deeds' mortgage books.

"2.3 The Register of Deeds' Office filed maps, plats, subdivision plans, and surveys.

"2.4 The Probate Court's Office will books, etc.

"2.5 The Appraiser's Office records consisting of any existing lot books, tract books, assessed descriptions, property record cards, index cards, etc.

"2.6 The County Clerk's Office records of annexations, street or alley closings or openings, taxing district boundaries and descriptions, assessment rolls, transfer books and a current taxing unit map showing the number and metes and bounds of every taxing unit or any portion of a taxing unit located within the County.

"2.7 Any other state or county office or agency that has recorded information relating to political subdivision boundaries including, but not limited to, District Courts, city clerks, city engineer's offices, planning and zoning commissions, etc."

In addition to this information that will be collected from the County, Conley, Kight, and Eckford is under contract to "make a reasonable attempt to locate, copy and deliver to the county the following additional mapping aids:

"3.1 Original township plats and surveyor's field notes used in the establishment of township, range and section lines.

"3.2 Rights-of-way acquisition surveys or plans for all federal, state, city and county roads, streets or highways which currently exist in the county.

"3.3 1:24,000 United States Geological Survey (USGS) 7 1/2' SERIES Topographic map sheets covering the entire county.

"3.4 Railroads, cross-country type utility rights-of-way plans and all trunkline pipeline easements."

After the contract period, the specific wealth of information that will be turned over to the county is staggering. Listed under "Summary of Items to be Delivered by the Contractor" in the Contract are the following:

"1. All aerial photography products used in the preparation of the property ownership maps.

"2. The film positive photo screened enlargements as outlined and prepared under the technical specifications or where provided by the county.

"3. One (1) complete set of final ownership maps in map number order, index maps and title sheets on 4 mil, dimensionally stable, double-matte polyester film material as outlined by the specifications.

"4. All work map overlays created for each final map sheets in map number order.

"5. Two (2) sets of quality Diazo paper prints of each ownership map, two (2) Diazo prints each of the index map screened enlargement and two (2) composite prints of each screened enlargement and the ownership map. All prints will be delivered in map number order.

"6. Any Computer Tapes or other items created.

"7. All reports and errata lists as required by the technical specifications.

"8. Map work cards containing assessment roll information and ownership map information arranged by map and parcel number.

"9. Any and all maps, plats, plans, microfilm or other information obtained or produced in order to complete this project. All map related items or material will have the map reference number shown and will be sorted in map number order prior to delivery to the county.

"10. One (1) negative and two (2) positive copies of 35mm microfilm of all ownership maps. * * *"

It is clear, from these selected sections of the Riley County Contract Agreement and Technical Specifications for Property Ownership Mapping Services and Ownership Maps, Riley County officials will gain not only the required information for reappraisal purposes; but will also have within their holding a valuable stock of information for planning and other uses.

CHAPTER FIVE

CONCLUSION

In previous chapters put forward was a general discussion of GIS terms, concepts, and proven GIS applications. Also, reviewed were the experiences and concerns of professionals in the field of GIS as they relate to the implementation process, political will, information files, and economic support. Finally, before the inventory of existing data bases, a brief discussion of what can be gained from reappraisal and what reappraisal means in a GIS context to a county government.

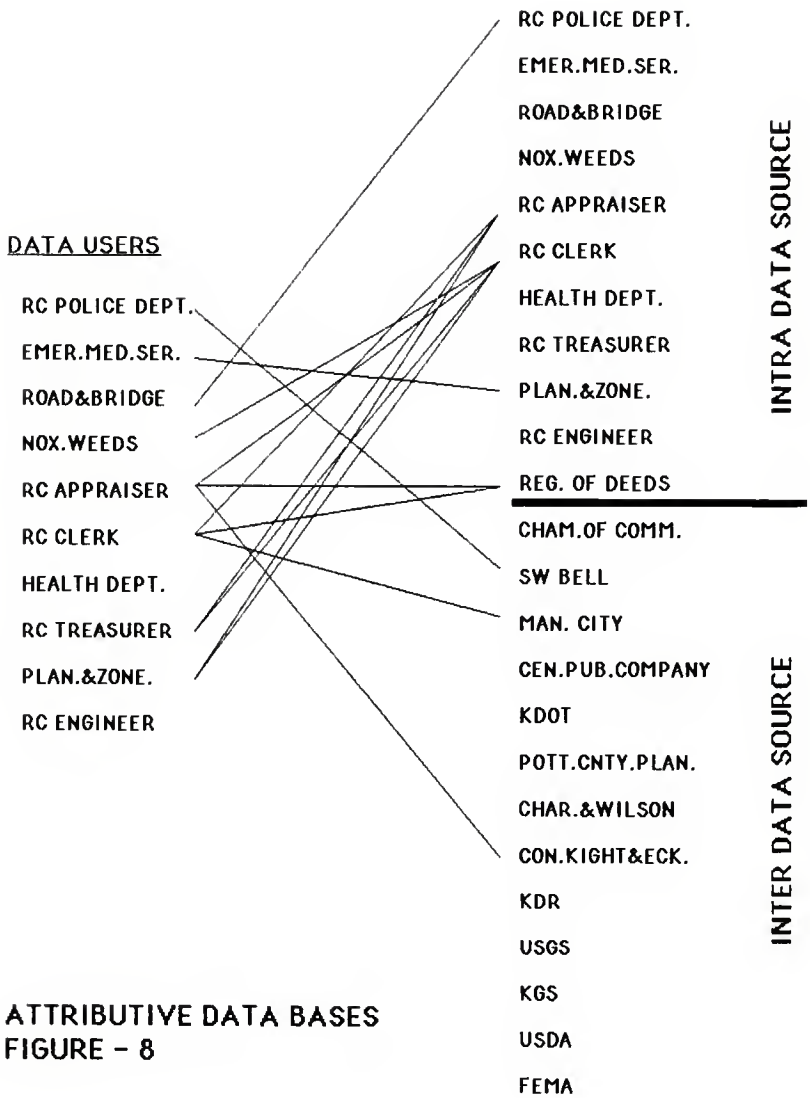
In the previous chapter pertinent offices and departments in Riley County were inventoried to determine the present information maintained and used. The attributive data relationship to spatial characteristics that might assist these offices and departments in their duties and responsibilities was shown. Each office and department represented a separate section in this chapter to better understand their information needs. As each section concludes with comments on that particular department or office there is little need to restate, again what has already been stated. What is of benefit to this study is the intra and inter networks that are apparent in the acquisition of data.

Presented here are two relationship charts that show where a county department goes for attributive and spatial data. These are sources of information. These charts are rather similar to input-

output communication flows and one is tempted to apply a communication systems approach model to better understand these relationships (Rogers 1976). However, one would only distort this data and wholy misinterpret the relationships as they are shown. Keep in mind that these networks only document the "material" use of data from the corresponding data source. For instance, Emergency Medical Service is dependent on Riley County Police Department for 911 dispatch services. But, since EMS has no "physical" data source from RCPD, emergency dispatch is sent to EMS by either phone or radio but not by a computer terminal, this important link is not shown.

ATTRIBUTIVE DATA BASES:

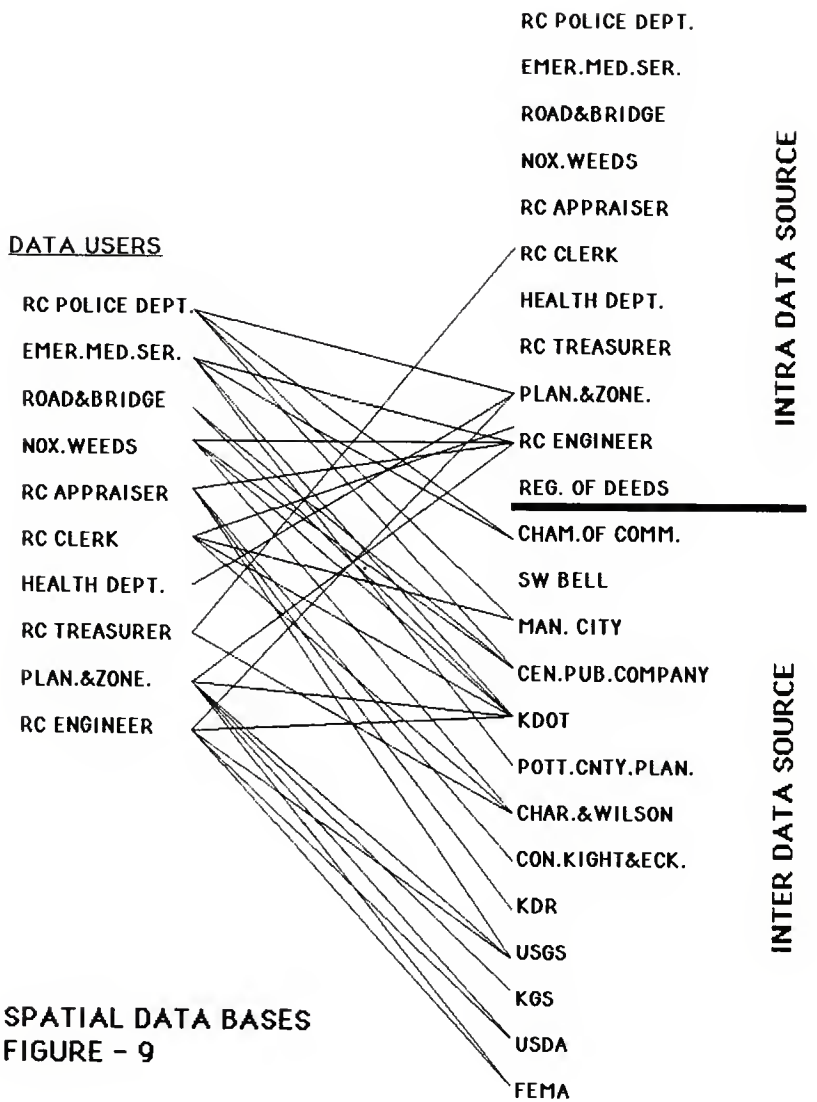
Beginning with the "Attributive Data Bases" Figure it is readly apparent that six (6) of the departments consult one or no outside sources for their attributive data. The County Appraiser, County Clerk, County Treasurer, and Planning and Zoning Departments are the only departments that consult more than one data source for information. The main information providers of these four are the County Clerk and the County Appraiser. From this Figure, one may conclude that attributive data is obtained either from the department or office itself or from other County offices.



ATTRIBUTIVE DATA BASES
FIGURE - 8

SPATIAL DATA BASES:

In the case of the "Spatial Data Bases" Figure, it is readly apparent that the greatest number of spatial data sources are outside of County government. Outside sources are consulted rather evenly, the reason seven (7) of the County offices consult the Kansas Department of Transportation is for the General Highway Map. Besides KDOT, the main provider of spatial data is the Riley County Engineer. But, this too needs to be qualified as most of these are for the County Section Maps that the County Engineer produces. It is possible to conclude that Riley County Offices are more dependent on outside sources for spatial data than for attributive data.

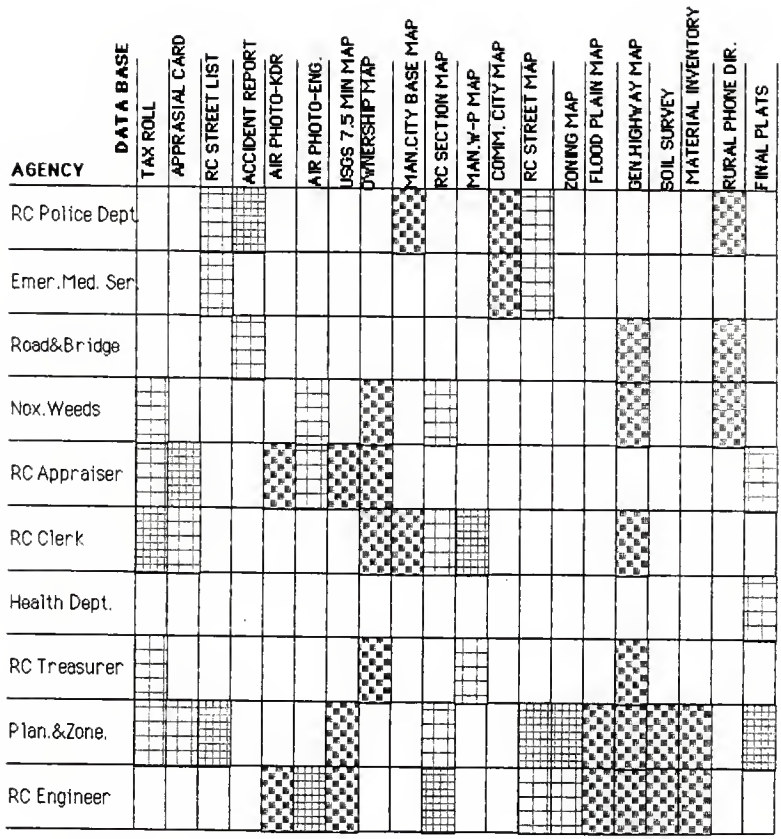


SPATIAL DATA BASES
FIGURE - 9

MATRIX OF COMMONALTIES:

Thus far, the conclusions drawn have shown that, most spatial data is obtained from "inter data sources" or information sources outside of explicit county government units. And, attributive data that is not created from the specific county units is obtained from "intra data sources" or other county governmental units, especially the County Clerk and the County Appraiser. A "Matrix of Commonalties" is helpful to better understand what specific data bases are used by more than one County office and department. The following Figure identifies the elements that would be necessary for a GIS data base design. Again, a difficulty in interpreting this matrix is that there are no values associated with the relationships. That is, it is unknown how critical the specific data base is to the performance of a particular departments tasks. However, should Riley County pursue the acquisition of a GIS, this matrix increases the awareness of critical information that would be of use to decision makers.

There are ten data bases that contain information that is critical to more than three departments or offices. Three of the ten are attributive data bases: Tax Roll, Appraisal Card, and the Riley County Street Name List. The remaining seven spatial data bases are: Air Photo (County Engineer), USGS 7.5 Minute Map, Charlson and Wilson County Ownership Map, Riley County Section Map, Riley County Street Map, General Highway Map, Riley County Rural Phone Directory, and Final Plats.



PUBLISHED &/USED BY COUNTY OFFICE

PUBLISHED BY OTHER COUNTY OFFICE/ USED BY COUNTY OFFICE

PUBLISHED BY A NON-COUNTY AGENCY/ USED BY COUNTY OFFICE

MATRIX OF COMMONALTIES
FIGURE - 10

IMPORTANCE OF REAPPRAISAL TO GIS:

The race began in August of 1985 and the finish line is 1 January 1989 (KSA 79-1476). In little over three years, Riley County must map 390,824 acres of land; locate, measure and describe over 15,000 thousand improvements; and appraise some 21,000 parcels of property. And, whether reappraisal is completed or not a new property assessment classification system goes into effect on 1 January 1989 (Donatello 1987). The importance of reappraisal, to GIS, is that, "Before actually appraising a property, the appraiser must be able to locate and identify it (Donatello, 1987)." This means each of the 21,000 parcels in Riley County will be mapped to provide current property ownership maps. A collection of standard maps is a real wealth of needed information for Riley County, but even more so will be the attributive data base that is to be created and updated simultaneously.

The cost for reappraisal for Riley County will be near $36.42 per parcel or a total cost of $764,726. No doubt, the parcel mapping could be updated with a cadastre mapping system, but the specific data needs for appraisal purpose necessitate the geo-link to an attributive data file. It is apparent from selected specification sections of the Contract Agreement and Technical Specifications for Property Ownership Mapping Services and Ownership Maps for Riley County a wealth of information will be collected for the County's reappraisal mapping requirements.

The point is that this information will be supplied to the county and its cost of collection, as would be necessary for a GIS, is a mute point because reappraisal requires its collection regardless. It is an expense that may be figured as both "priceless" and "free." To conclude on this final note, from a Kansas Department of Revenue publication [PV-RA-1 (11/86)], regarding the question what other uses property ownership maps might be used for, it specifies:

> "A. GOVERNMENT USES -- Land use studies; zoning; Flood control; Census; Bus routing; Base for building road and school district maps, precinct maps, soil survey maps, sewer district maps, and special assessment maps.
>
> "B. PUBLIC USES -- Route surveys; Abstracts of title; Real estate tract maps; Base for building public utility maps, highway maps, zip code maps, and atlases.
>
> "C. EDUCATIONAL USES -- Statistical studies; Crop cover studies and surveys; Vegetation studies and surveys; Land use studies; Base for building Multi-Purpose Geographic Information System."

RECOMMENDATIONS FOR FURTHER STUDY:

There are many unanswered questions that could offer additional avenues of research. What would be the findings of a system analysis on the data findings? What is the "weight" or utility of the various data bases? What departments would need a GIS work station for day to day operation? How might coalitions be built and maintained for such a system? Which department should take the task and responsibility for implementing such a system? Without further study, it is impossible to answer any of these questions.

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Steiner, Frederick R. and Kenneth R. Brooks. "Ecological Planning Information," Land Use Planning. Washington State University-Pullman, 1978.

APPENDIX A

Riley County Attorney
Attributive Data Bases
Bill Kennedy
105 Courthouse, Manhattan: 537-6390

Note: The Riley County Attorney does not use spaital data in the regular course of their duties.

D/B NAME: Offenders Priories File
MAINTAINED BY: Cnty Attorney
SOURCE: Cnty Attorney (other sources)
SIZE: approx. 1 200 per year
TYPE OF INFO: Previous Charge Record
TYPICAL USE: (see below)

The "offenders prioris file is used to determine an offenders past criminal history and it is permanently kept on file in the County Attorney's Office. Adjustments to this file are to make additions.

D/B NAME: Individual Offender Files
MAINTAINED BY: Cnty Attorney
SOURCE: Cnty Attorney
SIZE: approx. 1 200 per year (+94 juvenal & +11 mental or alcohol related)
TYPE OF INFO: (see below)
TYPICAL USE: (see below)

The "individual offender file" is a composite of all current information relating to an offeners action and charges. This file includes a copy of the RCPD report, a copy of the pre-sentence report and various legal descriptions and actions taken.

APPENDIX B

COMMUNITY CORRECTIONS
Attributive Data Bases

Frank McCoy
105 Courthouse Plaza, Manhattan: 537-6380

D/B NAME: Pre Sentence Report
MAINTAINED BY: Community Corrections
SOURCE: Community Corrections
SIZE: all offenders (approx. +50 per year)
TYPE OF INFO: (see below)
TYPICAL USE: prisoner supervision management
(Manual)

The "Pre-Sentence Report" includes the following information on an offender: name, address, relatives, past criminal history, military status, employment history, educational history, hospitalization, institutional history, and psychiatric test score results and interpretations.

D/B NAME: Contact Log
MAINTAINED BY: Community Corrections
SOURCE: Community Corrections
SIZE: all offenders (200 enters per year per person)
TYPE OF INFO: (see below)
TYPICAL USE: serves as a tracking system to document contacts with prisoner
(Manual)

The "Contact Log" documents ever contact made with an offender whether a relative or other person while that person is incarcerated and is updated daily.

APPENDIX C

Riley County Health Department
Attributive Data Bases
Chuck Murphy
2030 Tercumseh Rd., Manhattan: 776-4779

D/B NAME: Active Sewage System File
MAINTAINED BY: Health Dept.
SOURCE: Planning and Zoning
SIZE: approx. 40 per year
TYPE OF INFO: (see below)
TYPICAL USE: sewage system location

The "Active Sewage System File" documents the location of sewage systems in Riley County, the size of a septic tank, type, and any repairs or alterations to such systems. This information is used to determine the status of land use and occupancy permits.

Riley County Health Department
Spatial Data Bases
Chuck Murphy
2030 Tercumseh Rd., Manhattan: 776-4779

MAP NAME: Sub-Division Final Plats
MAINTAINED BY: Planning & Zoning
SCALE: 1:100 & 1:50
NO. SHEETS/SET: 110 Plats Total
SHEET SIZE: 18 x 24" and varies
BASE MAP/SOURCE: firms & individuals

The importance of a "Sub-Division Final Plat" to the Health Department is the specifics of the sewage systems for the development. A typical final plat contains both spatial and attributive data. The County Health Department signs off on all Final Plats.

APPENDIX D

Riley County Personnel Department
Attributive Data Bases
Brad Buckner
110 Courthouse, Manhattan

D/B NAME: Employee Information File
MAINTAINED BY: Personnel Dept.
SOURCE: Personnel Dept.
SIZE: approx. 150 individuals
TYPE OF INFO: (see below)
TYPICAL USE: personnel management
(Manual)

The "Employee Information File" data base includes the following information on Riley County employees: name, sex, address, birth date, date of hire, education level, skills, social security number, marital status, number of dependants, department employed in, title, supervisor, performance appraisal, salary, benefit information, and position. This information is used to track personnel work history, provide for benefits, and track unemployment costs.

APPENDIX E

G.I.S. DEVELOPMENT PROCESS MODEL

I. FEASIBILITY STUDY
- Need
- Project Concept
- Automation Alternatives
- Organizational Factors
- Preliminary Cost Benefit Assessment
- Management Involvement
- Project Plan

IIa. USER REQUIREMENTS ANALYSIS
- Functionality
- Data
- Top Down
- Bottom Up
- Current Practices
- Current & Future Needs

IIb. EXISTING DATA & SYSTEMS ANALYSIS
- Data Format
- Data Currency & Accuracy
- Data & System Redundancy & Duplications
- System Interfaces

IIc. Environmental Factors
- Organizational Mandates & Responsibilities
- Organizational Structure & Operations
- Regulatory Environment

III. SYSTEM DESIGN
- Organization
- Database
- Software
- Hardware

IVa. PILOT PROJECT

Evaluate Database
(Design)
Evaluate Potential Vendors
(System Acquisition)
Evaluate Procedures
(Implementation)

IVb. COST BENEFIT ANALYSIS

Cost Savings
Revenue Generation
Additional Benefits
Efficiency/Savings Ratios
Payback
Lifecycle

V. IMPLEMENTATION PLAN

Phased Implementation
Early Deliverables
Flexibility
Organization
Core System & Applications

VI. SYSTEM ACQUISITION & DEVELOPMENT

Software
Hardware
Database Design
Development

VII. DATA CONVERSION

In House/Contract
Time Frame
Quality Control
Transition

VII. SYSTEM IMPLEMENTATION

Organization
Training
Transition
Application Development

APPENDIX F

ANNOTATED BIBLIOGRAPHY

Belknap, Raymond K. and John G. Furtado. Three Approaches to Environmental Resource Analysis, The Conservation Foundation, Washington, D.C., 1967, 25 pages.

The authors review the environmental resource analysis approach of Philip H. Lewis. This article provides a good background of overlay techniques for GIS applications.

Berry, Joseph K. "Computer-Assisted Map Analysis: Potential and Pitfalls," Photogrammetric Engineering & Remote Sensing, October 1987, pages 1405-1410.

In this article quantitative approaches to digital map processing are described and potentials and pitfalls of map analysis are identified.

_____. "Learning Computer-Assisted Map Analysis," Journal of Forestry, October 1986, pages 39-43.

The author suggests how basic math and statistics can help a user better understand GIS. This article simplifies some of the more difficult concepts revolving around GIS technology and applications.

Bucko, Daniel and Julius Gy. Fabos. Annotated Bibliography The Metropolitan Landscape Planning Model (METLAND) 1971-1984, Massachusetts Agricultural Experiment Station, College of Food and Natural Resources, University of Massachusetts at Amherst, Research Bulletin Number 694/July 1984, 48 pages.

This annotated bibliography spans fourteen years of GIS and environmental research at the University of Massachusetts. Most publications listed are available through the research group.

Burns, Tony. "Municipal Applications for GIS," Computer Applications for Planners, Papers from the 1986 Four-State Conference American Planning Association, Little Rock, Arkansas, 1986, pages 92-104.

The author covers the full range of GIS from designing the system, software selection, to implementation and applications.

Byler, Richard P. "Building a Constituency: The RMLR Experience," Urban, Regional, and State Government Applications of Computer Mapping. Harvard Library of Computer Graphics, 1980 Mapping Collection, 1980, pages 30-39.

The author gives his experience with the "Regional Mapping and Land Records (RMLR) program which included five major utilities in southeastern Pennsylvania. It is a good source for appreciating what can go wrong and right during implementation of a GIS.

Castle, Gilbert H. III, "A Picture is Worth a Thousand Words," Computer Applications for Planners, Papers from the 1986 Four-State Conference American Planning Association, Little Rock, Arkansas, 1986, pages 71-82.

The author gives an overview of what a GIS is and demonstrates practical uses such systems can offer. Also, provided is a list of 12 cities and counties, 7 states, and 16 vendors involved with GISs.

Chrisman, Nicholas R, "Design of Geographic Information Systems Based on Social and Cultural Goals," Photogrammetric Engineering & Remote Sensing, October 1987, pages 1367-1370.

Chrisman is an author who is concerned with the ethical questions that GISs present and has focussed his research towards such concerns. In this article Chrisman defines the fundamental concerns, as he sees them, that have been overlooked by other researchers in the field. This is an opinion paper.

Deines, Vernon P. County Planning and Zoning In Kansas 1984: Preliminary Findings. The Center For Regional and Community Planning, 1984, 30 pages.

This report documents the history and current status of county planning and zoning within the State of Kansas. 91 counties, of 105, responded to the questionnaire.

Devine, Hugh A. and Richard C. Field. "The Gist of GIS," Journal of Forestry, August 1986, pages 17-22.

The authors give a basic review of GIS and provide a cost-benefit analysis model for purchasing such systems.

_____. "GIS Applications," Journal of Forestry, September 1986, pages 35-41.

The authors with other collaborators introduce some present GIS forestry applications used at TVA and for industrial forest management.

Donatello, George A. Kansas Reappraisal. Kansas Department of Revenue, Division of Property Valuation, 1987, 17 pages.

The author provides a state perspective of Kansas Reappraisal and the scope of the reappraisal project.

Dueker, Kennth, "Geographic Information Systems and Computer-Aided Mapping," Journal of the American Planning Association, Summer 1987, pages 383-390.

This article distinguishes computer-aided mapping from geographic information systems. Planners are cautioned about acquiring computer-aided mapping systems that lack the geographic information systems data models that most spatial analysis requires.

_____, "Multipurpose Land Information Systems: Technical, Economic and Institutional Issues," Photogrammetric Engineering & Remote Sensing, October 1987, pages 1367-1370.

This article explores the application of geographic information systems technology to build multipurpose land information systems as a means of dealing with land records modernization problems.

Faust, Nickolas, "Automated Data Capture for Geographic Information Systems: A Commentary," Photogrammetric Engineering & Remote Sensing, October 1987, pages 1387-1390.

This is a brief article that covers techniques for automated data encoding and evaluates present state of the art techniques.

Getter, Russell. GIS - A State Perspective. Kansas Division of Information Systems and Communications (DISC), 1987, 16 pages.

This is a collection of overheads used by the Division of Information Systems and Communication (DISC). It serves

as a base for determining policy goals of DISC and the State of Kansas.

Gray, Robert J. and Margaret S. Maizel. A Survey of Geographic Information Systems. The American Farmland Trust, 1985, 132 pages.

This report identifies and documents the characteristics of existing GISs which could be used to evaluate the agricultural viability of farmland and the importance of conserving natural resources. Sixteen GIS programs are reviewed.

Greenlee, David D. "Raster and Vector Processing for Scanned Linework," Photogrammetric Engineering & Remote Sensing, October 1987, pages 1383-1387.

This is a technical article describing the details of processing scanned data for GISs.

Hayes, Dexter & Dale Lambert, "Getting Started in Geoprocessing," Computer Applications for Planners, Papers from the 1986 Four-State Conference American Planning Association, Little Rock, Arkansas, 1986, pages 105-111.

Hayes provides a conceptual design for Management and Planning System (MAPS), a GIS management model.

Johnston, Kevin M. "Natural Resource Modeling in the Geographic Information System Environment," Photogrammetric Engineering & Remote Sensing, October 1987, pages 1411-1415.

This study explores the creation and implementation of a land management model developed for a Canadian timber company.

Kansas Water Office. Kansas Water Plan - Quality Section. Kansas Water Authority, 1987, 8 pages.

This position paper underlines the Kansas Water Office strategy for protection of the environment.

Keating, Terrence. "An Integrated Topoligic Database Design for Geographic Information Systems," Photogrammetric Engineering & Remote Sensing, October 1987, pages 1399-1402.

Several database management system (DBMS) design concepts used by Kork's Geographic Information Management System (KGIS) for the creation, maintenance, and rapid retrieval of geographically referenced data sets are discussed.

Logan, Thomas L. and Nevin A. Bryant. "Spatial Data Software Integration: Merging CAD/CAM Mapping with GIS and Image Processing," Photogrammetric Engineering & Remote Sensing, October 1987, pages 1391-1395.

This article touches on the potential of integrating CAD/CAM mapping with GIS and image processing. The authors also discuss why such a problem exists and compare and review bias that lead to one system preference at the cost of the other two.

Lupien, Anthony E. "Network Analysis in Geographic Information Systems," Photogrammetric Engineering & Remote Sensing, October 1987, pages 1417-1421.

The author reviews network analysis techniques for the application of a GIS.

Maffini, Giulio, "Raster versus Vector Data Encoding and Handling: A Commentary," Photogrammetric Engineering & Remote Sensing, October 1987, pages 1397-1398.

It is apparent that Maffini favors the vector data encoding for GIS. His article addresses conformity in data structures.

Moore, Patricia A. Management's Use of Maps, Harvard Library of Computer Graphics/1980 Mapping Collection Harvard University, Vol. 7, 1980, 103 pages.

This document reviews display techniques and thematic mapping for the promotion of spatial information. It does not review GIS. There are 13 articles in this publication.

_____. Computer Mapping of Natural Resources and the Environment, Harvard Library of Computer Graphics/1980 Mapping Collection Harvard University, Vol. 10, 1980, 131 pages.

This document primarily reviews CAD/CAM applications and only suggests possible GIS applications for natural resource and environmental mapping. The document includes 15 papers on such applications and also, for satellite-derived data or remote sensing.

_____. Urban, Regional and State Government Applications of Computer Mapping, Harvard Library of Computer Graphics/1980 Mapping Collection Harvard University, Vol. 11, 1980, 232 pages.

This document includes 26 articles that are applicable to GIS. Most of the software that is reviewed are mainframe systems, but the reading is valuable.

Morgan, III, John M. "Academic Geographic Information Systems Education: A Commentary," Photogrammetric Engineering & Remote Sensing, October 1987, pages 1443-1445.

The author discusses what the content, course prerequisites, hardware, software, textbooks, and other materials for an academic GIS course should be.

Niemann, Jr., Bernard, "Results of the Dane County Land Records Project," Photogrammetric Engineering & Remote Sensing, October 1987, pages 1371-1378.

This paper presents the results of the Dane County Land Records Project, a four-year research venture involving numerous local, state and federal agency cooperators. The project has demonstrated the potential of multipurpose land information systems to significantly improve both the efficiency and equitablity with which rural land management programs are implemented.

President & Fellows of Harvard College. Management's Use of Maps, Harvard University, Laboratory for Computer Graphics and Spatial Analysis, Vol. 1, 1979, 64 pages.

This document includes 7 articles on various graphic mapping packages and applications. The applications are not GIS, but serve as an example of what is not a GIS.

_____. Urban, Regional and State Applications, Harvard University, Laboratory for Computer Graphics and Spatial Analysis, vol. 3, 1979, 195 pages.

This document includes 16 articles on various applications for GISs. A must read to better appreciate the possibilities such systems offer.

Ripple, William J. and Veit S. Ulshoefer. "Expert Systems and Spatial Data Models for Efficient Geographic Data Handling," Photogrammetric Engineering & Remote Sensing, October 1987, pages 1431-1433.

The authors review implications that would suggest that by linking a GIS to an expert system the ease in using a GIS would be greatly increased.

Robinson, Vincent B. and Andrew U. Frank. "Expert Systems for Geographic Information Systems," Photogrammetric Engineering & Remote Sensing, October 1987, pages 1435-1441.

This paper discusses the nature of expert systems with special attention given to the construction process. The authors suggest that future research needs of geographic information systems will be addressed with the context of expert system development.

Schneider, Devon M. and Syed Amanullah. Computer-Assisted Land Resources Planning, American Planning Association, Planning Advisory Service Report No. 339, 1978, 46 pages.

This is an excellent overview of GISs. As advancements in the field of GIS have been striking this report is also an excellent source for understanding the history of such systems.

Somers, Rebecca, "Geographic Information Systems in Local Government: A Commentary," Photogrammetric Engineering & Remote Sensing, October 1987, pages 1380-1382.

This is a general article that covers various application models for GIS and other potential concerns and uses.

Steiner, Frederick R. and Kenneth R. Brooks. "Ecological Planning Information," Land Use Planning. Washington State University-Pullman, EM 4367 August 1978, 5 pages.

This is a bulletin provided by the Washington State University Cooperative Extension Service. The authors briefly present an ecological planning method model. Also reviewed is a case study of their model.

Thorpe, John A. and Duane M. Gilbert. "AM/FM Requirements of Geographic Information Systems: A Commentary," Photogrammetric Engineering & Remote Sensing, October 1987, pages 1403-1404.

The authors discuss the Automated Mapping/Facilities Management (AM/FM) needs of utility companies, and how GIS can fulfill these needs.

Walsh, Stephen J. "Recognition and Assessment of Error in Geographic Information Systems," Photogrammetric Engineering & Remote Sensing, October 1987, pages 1423-1430.

This article addresses the potential GIS has for error inherent levels of data manipulation.

GEOGRAPHIC INFORMATION SYSTEMS: A REVIEW OF COUNTY SPATIAL AND ATTRIBUTIVE DATA BASE NEEDS AND APPLICATIONS

by

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AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

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The underlying assumption of this research is that the existing data maintained and used by a county government is the information that will give the greatest utility to the most users in a spatial geographic data processing environment or GIS. Or, stated in the more esoteric, it is asserted that; standards are manifested in the status quo.

This report seeks to inventory information, as it relates to spatial geographic data, maintained and used by county offices and departments in Riley County Kansas. Also, it discusses the type of data that would be required for the implementation of a single geographic information system for the benefit of the greatest number of Riley County departments and offices. Numerous terms and concepts are defined to better understand just what constitutes a GIS. Also included is a discussion of the implementation process, political will, needed information files, and useful GIS applications.

Fifteen Riley County offices and departments have been interviewed to determine the maps (spatial data) that are produced, maintained or used by that office or department. Inventoried was map name, source, scale, number of sheets/sets, sheet size, base map/source, and major map features. Each office and department has also been interviewed to determine the data bases (attributive data) that are maintained and developed by that office or department. Inventoried was data base name, source, size, type of information, and typical use. From this inventoried data "intra" and "inter" data sources are documented and a matrix of commonalties is drawn to identify the elements that would be necessary for a GIS data base design.